

Unclas

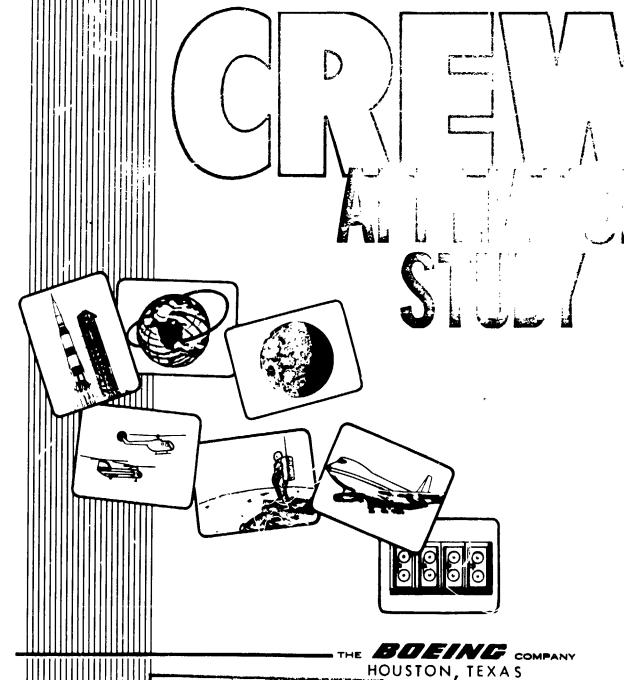
("ASA-C"-144455) TAFA APPTTANCE CONCEPTS. AUTHAS A' MODEAUIX C: AUDHTAB SDECE STEETION *POTTMMORS SHOPOPPING PIGINFEPING DATA (Roeing Co., Houston, Tex.) 371 p HC \$1^.0′ Unclass CSCL ^5H G3/F4 41925

D2-118561-4

NASA CR-

147455

CREW APPLIANCE CONCEPTS



July 25, 1975

BEST COPY **AVAILABLE**

DOCUMENT NO. D2-118561-4

TITLE CREW APPLIANCE CONCEPTS

Contract NAS 9-13965

July 18, 1975

Prepared by

B. W. Proctor R. P. Reysa D. J. Russell

CREW APPLIANCE CONCEPTS APPENDIX C MODULAR SPACE STATION APPLIANCES SUPPORTING ENGINEERING DATA

1

PREFACE

A study of crew appliances for advanced spacecraft is being performed for NASA JSC by the Boeing Aerospace Company under Contract NAS 9-13965. A large number of appliance concepts for the galley, personal hygiene, housekeeping, and other areas have been investigated for application to the Shuttle Orbiter and Modular Space Station missions. This document presents the background to and results of trade studies to determine the optimum appliance systems for these two vehicles.

An index file containing abstracts for 299 appliance-related documents was developed during the initial literature search for this study. The original file will be delivered to and retained by NASA.

Due to the large volume of library references and appliance engineering data used for the trade studies, it was necessary to present the supporting information to the concept report in separate appendices as follows:

- <u>APPENDIX A</u> In this appendix, the complete bibliography used for the appliance study is listed in three forms: numbered, alphabetized, and sorted by subject matter.
- APPENDIX B This appendix contains the supporting engineering data used for all appliance concepts considered for Shuttle Orbiter, including plotted and tabulated trade study results for each appliance function.

Ü

APPENDIX C - This appendix contains the supporting engineering data used

for all appliance concepts considered for Modular Space

Station, including plotted and tabulated trade study results

for each appliance functic

TABLE OF CONTENTS

| SECTION | | PAGE |
|--|--|--|
| | VOLUME I OF V | |
| | PREFACE ABSTRACT AND KEY WORDS. TABLE OF CONTENTS. ILLUSTRATIONS AND TABLES. | iii . iv |
| 1.0 2.0 3.0 3.1 3.2 3.3 4.0 4.1.1 4.1.2 4.1.3 4.1.4 4.2.1 4.2.2 4.2.3 4.2.4 5.0 5.1 5.2.2 5.2.5 5.2.5 5.2.5 5.2.5 5.2.5 6.1.1 6.1.3 6.1.4 6.1.5 6.1.5 6.1.5 6.1.5 6.1.5 6.2.6 | INTRODUCTION. SUMMARY APPLIANCE CONCEPT FUNCTION DESCRIPTION. MISSION BASELINE DESCRIPTION. APPLIANCE SYSTEM DESCRIPTION. APPLIANCE CONCEPT FUNCTION MATRIX VEHICLE CREW APPLIANCE REQUIREMENTS SHUTTLE CREW APPLIANCE REQUIREMENTS Shuttle Food Management Subsystem Requirements. Shuttle Personal Hygiene Subsystem Requirements Shuttle Housekeeping Subsystem Requirements Shuttle Off-Duty Subsystem Requirements Shuttle Off-Duty Subsystem Requirements Space Station Food Management Subsystem Requirements Space Station Personal Hygiene Subsystem Requirements Space Station Housekeeping Subsystem Requirements Space Station Off-Duty Subsystem Requirements Space Station Off-Duty Subsystem Requirements WEIGHTED TRADE STUDY. WEIGHTING DISTRIBUTION RATIONALE. APPLIANCE CONCEPT SELECTION RATIONALE APPLIANCE CONCEPT SELECTION RATIONALE Reliability, Maintenance, and Safety. Weight. Power and Thermal Volume. Recurring Cost. APPLIANCE CONCEPT TRADE PROGRAM DESCRIPTION CREW APPLIANCE SYSTEM OPTIMIZATION. SHUTTLE APPLIANCE SYSTEM OPTIMIZATION Shuttle Optimized Food Management Subsystem Shuttle Optimized Food Management Subsystem Shuttle Optimized Off-Duty Activities Subsystem Shuttle Optimized Appliance System. Shuttle Optimized Appliance System. SPACE STATION APPLIANCE SYSTEM OPTIMIZATION Space Station Optimized Food Management Subsystem | 2-1 3-1 3-1 3-7 3-1 4-1 4-2 4-1 4-1 4-1 4-1 5-1 5-1 5-1 5-1 5-1 6-2 6-1 6-1 6-1 6-1 6-1 |
| 6.2.2 6.2.3 6.2.4 6.2.5 | Space Station Optimized Personal Hygiene Subsystem Space Station Optimized Housekeeping Subsystem Space Station Optimized Off-Duty Activities Subsystem | 6-21 6-23 6-28 |



TABLE OF CONTENTS (Continued)

| SECTION | | b VCI |
|--|---|--|
| | VOLUME I OF V (Continued) | |
| APPENDIX A | - BIBLIOGRAPHY | |
| 1.0 2.0 3.0 4.0 5.0 6.0 | ILLUSTRATIONS AND TABLE | A1-1 A2-1 A3-1 A4-1 A5-1 |
| | VOLUME II OF V | |
| APPENDIX B | - SHUTTLE ORBITER APPLIANCES SUPPORTING ENGINEERING DATA | |
| 1.0 2.0 | PREFACE | B-iv B-vii |
| 2.0 | 1.0 FOOD MANAGEMENT. 1.1 FOOD STORAGE. 1.2 FOOD PREPARATION. 1.3 GALLEY CLEANUP. 2.0 PERSONAL HYGIENE. 2.1 WASTE COLLECTION/TRANSFER. 2.2 BODY CLEANSING. 2.3 PERSONAL GROOMING. | B2-4 B2-46 B2-61 B2-123 B2-124 B2-196 |
| | VOLUME III OF V | |
| APPENDIX B | (Continued) - SHUTTLE ORBITER APPLIANCES SUPFORTING ENGINEERING DATA | |
| 2.0 | TABLE OF CONTENTS | B-ii B-v |
| | 3.1 EQUIPMENT CLEANING | B2-310 B2-311 B2-354 |
| | | |
| | | B2-593 B2-594 |

TABLE OF CONTENTS (Concluded)

| SECTION. | | PAGE |
|------------|---|--|
| | VOLUME IV OF V | |
| APPENDIX C | - SPACE STATION APPLIANCES ENGINEERING DATA | |
| 1.0 2.0 | PREFACE TABLE OF CONTENTS ILLUSTRATIONS AND TABLES INTRODUCTION TECHNICAL DATA 1.0 FOOD MANAGEMENT. | C-iv C-vii C1-1 C2-1 |
| | 1.1 FOOD STORAGE. 1.2 FOOD PREPARATION. 1.3 GALLEY CLEANUP. 2.0 PERSONAL HYGIFNE 2.1 WASTE COLLECTION/TRANSFER 2.2 BODY CLEANSING. 2.3 PERSONAL GROOMING. | C2-4 C2-51 C2-68 C2-13! C2-136 C2-21! |
| | VOLUME V OF V | |
| APPENDIX C | (Continued) - SPACE STATION APPLIANCES ENGINEERING DATA | |
| 2.0 | TABLE OF CONTENTS | C-ii C-v |
| 2.0 | TECHNICAL DATA (Continued) 3.0 HOUSEKEEPING | C2-357 C2-397 C2-495 |
| | 4.1 ENTERTAINMENT | C2-608 |

4) 4)

ILLUSTRATIONS

| FIGURE | | PAGE |
|--------|--|--------|
| C1-1 | Crew Appliance System Organization | C1-2 |
| C1-2 | Crew Habitability and Appliance Functions and Concepts | C1-3 |
| C1-3 | Space Station Baseline Mission | C1-7 |
| C1-4 | Space Station Timeline | C1-8 |
| C2-1 | Composite Compaction Data for Trash Mixtures | C2-442 |

TABLES

| NUMBER | | PAGE |
|--------|---|----------------|
| C1-1 | COMPONENT FAILURE RATE AND REPAIR TIMES | C1-12 |
| C2-1 | PLANNED SKYLAB FOOD WEIGHT AND VOLUME (INCLUDING PACKAGING AND RESTRAINT) FOR 420 MAN-DAYS | C2-2 |
| C2-2 | REQUIRED SPACE STATION FOOD WEIGHT AND VOLUME (INCLUDING PACKAGING AND RESTRAINT) FOR 1080 MAN-DAYS | C2-2 |
| C2-3 | PENALTIES ASSOCIATED WITH VARIOUS TYPES OF DISHES CONCEPTS FOR SPACE STATION SIX-MAN CREW | C2-132 |
| C2-4 | VEHICLE PENALTIES FOR VARIOUS DISPOSABLE DISHES CONCEPTS ASSUMING NO DISHWASHER AVAILABLE | C2-133 |
| C2-5 | WEIGHT AND VOLUME OF DISHES/UTENSILS/CUPS TO BE USED WITH AUTOMATIC DISHWASHER/DRYER FOR SPACE STATION SIX-MAN CREW | C2-134 |
| C2-6 | SPACE STATION/SHUTTLE REFUSE SUMMARY | C2-39 8 |
| C2-7 | CLOTHES/LINENS USAGE RATES ASSUMED PER MAN WITH A CLOTHES WASHER/DRYER AVAILABLE | C2-571 |

1.0 INTRODUCTION

A large number of crew appliance concepts have been studied for applicability to the Modular Space Station and Shuttle Orbiter spacecraft, and detailed trade studies of the various concepts were conducted to choose the optimum appliance systems for both vehicles. Due to the volume of data used for the appliance trade studies, it was necessary to present the supporting information to the concept report in separate appendices. In this appendix are included all the engineering data collected for the appliances considered for Modular Space Station, as well as plotted and tabulated trade study results for each appliance function.

A crew appliance system organization chart was constructed, Figure C1-1, to thoroughly and orderly establish an appliance system. The appliance concepts considered for Modular Space Station were categorized within this system as listed in Figure C1-2. The engineering data and trade study results for the appliance concepts evaluated are presented in this appendix in the order given in Figure C1-2. All the appliance data apply to a sixman mission, with the baseline mission ground rules and assumptions given in Figure C1-3. Two basic missions were considered for Space Station:

(1) 180-day mission, and (2) 5-year mission with 180-day resupply.

The daily Space Station time schedule is illustrated in Figure C1-4.

The data used for trading alternate appliance concepts are presented in Section 2 of this appendix. The format used in the data presentation is as follows:

<u>Top Sheet Description</u>: This data sheet gives a description of the appliance function with the assumptions made for computing appliance size and penalties.

Figure C1-1. Crew Appliance System Organization

ORIGINAL PAGE IS
OF POOR QUALITY

| 1.0 | FOOD MANAGEMENT | 1.3.1.6 | Ultrasomic Mash - Centrifuge Drying |
|---------|---|----------|--|
| 1.1 | FOOD STORAGE | 1.3.1.7 | Electric Dry |
| 1.1.1 | A-bient Food Storage | 1.3.1.8 | Ultrasonic wash - rorce told bry Alr - Desiccant, Electrically Desorbed |
| 1.1.1.1 | Rigid Containers | 1.3.1.9 | Ultrasonic Wash - Force Hot Air Dry - Thermal Storada |
| 1.1.1.2 | Flexible Containers | 1.3.1.10 | Manual Wash - Manual Wipe Dry |
| 1.1.2 | Refrigerated Food Storage | 1.3.2 | Dishwasher/Dryer with Dishes |
| 1.1.2.1 | Space Radiator | 1.3.2.1 | Hot Water Spray - Centrifice Drving |
| 1.1.2.3 | Inermoelectric Air Cycle Turbine/Compressor | 1.3.2.2 | Hot Water Spray - Forced Hot Air Electric |
| 1.1.3 | Frozen Food Storage | 1.3.2.3 | Hot Water Spray - Forced Air/Desiccant/ |
| 1.1.3.1 | Space Radiator | · · | Electrically Heated |
| 1.1.3.2 | | 1.3.2.5 | |
| 1.1.3.3 | Air cycle iuraine/compressor | | and [|
| 1.2 | FOOD PREPARATION | 1.3.2.6 | Disposable Cups and Monmetallic Dishes - Reusable Metallic Utensils |
| 1.2.1 | Food Rehydration | 1.3.2.7 | Cups and |
| 1.2.2 | Food Marming | 1.3.2.8 | Disposable Cups and Nonmetallic Utensils |
| 1.2.2.1 | Heating Trays (Skylab) | 1329 | and Distes Reusable Cups and Metallic Utensils |
| 1.2.2.2 | Over - Hot Air Convention (Electric Heat) | | and Dishes |
| 6.2.2.1 | | 1.3.2.10 | Reusable Cups and Metallic Utensils - |
| 1.3 | GALLEY CLEANUP | 1.3.2.11 | Disposable Nonmetallic Dishes Reusable Cups and Metallic Dishes - |
| 1.3.1 | Dishwasher/Oryer Combination | 7 | Disposable Nonmetallic Utensils |
| 1.3.1.1 | Hot Water Spray - Centrifuse Drying | 1.3.6.16 | Reusable cups-Disposable Normetallic Utensils and Dishes |
| 1.3.1.2 | Spray | | |
| 1.3.1.3 | Spray | 2.0 | PERSONAL HYGIENE |
| 1.3.1.4 | Hot Water Spray Wash - Forced Cold Air | 2.1 | WASTE COLLECTION/TRANSFER |
| 1.3.1.5 | Lesiccant Hot Water Spray Wash - Forced Hot Air Dry - Thermal Storage | 2.1.1 | Fecal Collection/Transfer |

Figure C1-2. Crew Habitability and Appliance Functions and Concepts

Figure C1-2. Srew Habitability and Appliance Functions and Concepts (continued)

| • • • • | Mechanical Oscillations Mechanical Oscillations Fluidic Agitation Piston Agitation Cyclic Valve and Pump Squeeze Squeeze Squeeze Vater Spray Agitated Ultrasonic Ultrasonic Manual Washboard 10 Plain Recirculation Garment/Linen/Drying Forced Hot Air - Electric Forced Hot Air - Desiccant - Vacuum Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Force Cold Dry Air - Desiccant - Heat Regenerable Forced Convection Garman Vacuum Dry - Electric Heat Fediant Heat Rediant Heat Sciontesline - Forced Convection Clothesline - Forced Convection Garment/Linen : asher/Dryer-Disposable Clothes Garment/Linen : asher/Dryer-Disposable Clothes Fluidic Agitation/Forced Hot Air - Electric | |
|---|--|-------------------|
| 3.2.5.2 3.2.5.3 3.2.5.3 3.3 3.4 | 3.3.1.1 3.3.1.2 3.3.1.1.2 3.3.1.1.2 3.3.1.1.4 3.3.1.1.6 3.3.2.1.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.2 3.3.2.3 3.3.2.2 3.3.2.2 3.3.2.2 | • |
| Reusable Wet/Disposable Dry Wipes Disposable Wet/Dry Wipes (Prepackaged) Automatic Mop Reusable Cleaning Cloths/ Disposable Dry Wipes | O = 101 | .1 Vacuum Storage |
| 3.1.1.2 3.1.1.3 3.1.1.5 | 3.1.1.7 3.1.1.8 3.1.1.8 3.1.1.10 3.1.1.10 3.1.1.11 3.2.1.1 3.2.1.2 3.2.2.1 3.2.2.2 3.2.2.3 3.2.4.2 3.2.4.3 3.2.4.5 3.2.4.5 3.2.4.5 | 3.2.5.1 |

Figure C1-2. Crew Habitability and Appliance Functions and Concepts (continued)

| 3.3.3.2 | 3.3.3.2 Fluidic Agitation/Forced Hot Air - Thornal Storage Heated | 4.2.2 | Hand Exerciser |
|---------|--|---------|--|
| 3.3.3.3 | i. | 5.0 | MEDICAL |
| 3.3.3.4 | 3.3.4 Fluidic Agitation/Forced Air Drying - | 5.1 | STERILIZATION |
| 3.3.3.5 | 3.3.3.5 Water Spray Agitation/Forced Hot Air - | 5.1.1 | Autoclaves |
| 3.3.3.6 | 3.3.3.6 Water Spray Agitation/Forced Hot Air - Thormal Storage Heater | 5.1.1.1 | 5.1.1.1 Moist Heat 5.1.1.2 Dry Heat |
| 3.3.3.7 | 3.3.3.7 Water Spray Agitation/Forced Air | 5.1.1.3 | Ethylene Oxide |
| 3.3.3.8 | Drying - Clothesline 3.3.3.8 Water Spray Agitation/Electrically | 5.2 | PHYSICAL MONITORING |
| 3.3.3 9 | Heated - Clothesline 3.3.3 9 Disposable Clothes | 5.2.1 | Ergometer |
| | | | |

| WASH WATER PROCESSING | OFF-DUTY ACTIVITIES |
|-----------------------|---------------------|
| 4. | 0 |

| OFF-DUIT ACLIVILIES | ENTERTAINMENT |
|---------------------|---------------|
|) | - |
| 4 √. | • |

| | Player/Recorder |
|-------|-----------------|
| Music | Cassette F |
| 4.1.1 | 4.1.1.1 |

| Library | Books | Television |
|---------|---------|------------|
| 4.1.2 | 4.1.2.1 | 4.1.3 |

| Games | Handball | Dart Board |
|-------|----------|------------|
| 4.1.4 | 4.1.4.1 | 4.1.4.2 |

| CONDITIONING |
|-----------------|
| PHYSICAL |
| 4.2 |

^{4.2.1} Exer-gym

Figure C1-2. Crew Habitability and Appliance Functions and Concepts (concluded)

SPACE STATION MISSION DASELINE

- o 20,000 POUND MODULES (MAXIMUM)
- o BASELINE MISSION

O

- 6-MAN CREW (MALE/FEMALE)
- 90/180-DAY RESUPPLY
- o VEHICLE SYSTEM CAPABILITY
 - 1080 MAN-DAYS + 96 HOUR CONTINGENCY FOR UP TO 12 MEN

SPACE STATION REQUIREMENTS IMPOSED ON THE APPLIANCE SYSTEM

- o GRAVITY ZERO
- o ATMOSPHERE (LIVING QTR's)
 - PRESSURE

14.7 PSIA

- COMPOSITION

3.2 PSIA 02

11.5 PSIA No

- CO₂ CONCENTRATION
- o TEMPLRATURE (LIVING QTR's)

- RANGE (DRY BULK) 65°-75°F

- DEWPOINT

39° -62° F

- o OPERATIONAL LIFE
 - 10 YEARS/SCHEDULED MAINTENANCE
- o GENERAL
 - GAS VENTING ALLOWED/NONPROPULSIVE
 - LIQUID VENTING SHALL BE MINIMIZED/NONPROPULSIVE
 - JETTISON OF SOLIDS/SOLID WASTES SHALL NOT BE ALLOWED

SPACE STATION TIMELING

- o NOMINAL CREW DUTY CYCLE
 - SEE FIGURE C1-4

Figure C1-3. Space Station Baseline Mission

| O CO:SO GO:SO | 3 3 |
|---------------|----------|
| | ודח ורח |
| | nT1 |
| | |
| | ۲. |
| | 1 = |
| | T |
| | m |
| | |
| CS-30 | 00:00 |
| , | 1 |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Figure C1-4. . Space Station Timeline

1.0 (Continued)

1

Appliance Function Matrix. This table lists the following engineering data used for trading each appliance concept for a given appliance function:

- o Appliance usage time
- o Fluid consumables usage (e.g., amount of air or water lost to space)
- o Fluid interface requirements (type of fluid, flow rate, temperature, pressure)
- o Thermal requirement for maximum heat leak to cabin atmosphere and directly to the coolant circuit
- o Average and peak AC and DC electrical power requirement
- o Appliance total weight/volume penalty
- o Development cost indicator based on state-of-the-art rating and concept complexity
- o Total 180-day resupply weight for expendables

The thermal, electrical, weight, and volume requirements listed in the table represent the total penalties assumed for the appliance and used to trade against alternate concepts. For example, the weight tabulated for reusable washcloths for partial body washing includes an appropriate weight charge for a clothes washer and dryer assumed to clean the cloths. To see the detailed itemized breakdown of each of these penalties, the data worksheets, described later, should be consulted.

Alternate Appliance Concept Rating Plots. In this figure is plotted the rating (based on zero minimum and 100 maximum points) for each appliance

1.0 (Continued)

concept traded for a particular appliance function. These plots were generated by the TRADE computer program described in the concept report. Higher ratings indicate a more favorable concept based on the penalties considered and the weighting factors assumed. Two curves are given for each case: one for a 180-day mission, and the other for a 5-year mission with 180-day resupply.

<u>Appliance Concept Selection Matrix</u>. Four tables are included here giving the results of the computer trade and sensitivity analysis. These tables include the following:

- o Selection matrix for a 180-day mission. This lists the weight, power, volume, etc. rating and the summed total points for each of the concepts. The total points are adjusted proportionally to a scale of zero to 100 maximum points to yield the final comparative rating for each concept.
- o Sensitivity analysis for a 180-day mission. This table lists the comparative rating for each appliance concept assuming the weighting factor for each trade parameter (e.g., weight, power, volume, etc.) is increased or decreased individually by 50 percent while holding all other weighting factors constant. Thus, the sensitivity of the above trade to any single weighting factor may be seen.
- o Selection matrix for a 5-year mission with 180-day resupply. The trade data and method to obtain this matrix are identical to the

1.0 (Continued)

1

()

180-day mission matrix described previously except that resupply weight for expendables is added as a trade function. The comparative ratings for each concept are tabulated for the 5-year case in the same format as was done for the 180-day case.

o Sensitivity analysis for a 5-year mission with 180-day resupply. This table corresponds exactly to the table for the 180-day case described previously, except the added trade parameter of resupply weight is included.

Component Reliability/Maintenance/Safety List. This table itemizes the types and number of components used for each appliance concept and the number of items considered to be safety critical. Each component is numbered to identify it in the component reliability list given in Table C1-1. This list itemizes the reliability data used for each component in the computer selection trades.

<u>Appliance Concept Description</u>. Each concept is described verbally and a drawing presented where available.

<u>Appliance Concept Data Worksheets</u>. Two data sheets are included here which itemize the weight, volume, power, thermal, and consumables penalties associated with each appliance concept.

C1-11

TABLE C1-1
COMPONENT FAILURE RAIE AND REPAIR TIMES

| \$ | Confidit | ENI INILONE P | MATE AND REPAIR TIMES | , | |
|---------------------|---------------------------------|---------------------|---|---------------------|--------------------------------------|
| COMPONENT NUMBER | COMPONENT DESCRIPTION | REFERENCE NUMBER | FAILURE RATE (λx10-6) FAILURES/ MILLION HOURS | REFERENCE NUMBER | REPAIR TIMES (MTTR) HRS/REPAIR |
| 1 | MOTOR | 252 | 3.8 | - | 0.5+.2=.7 |
| 2 | PUMP . | 100 | 6.0 | 254 | 0.2+.25=.45 |
| 3 | SOLENOID VALVE | 100 | 0.72 | 254 | 0.1+.2=.3 |
| 4 | ACCUMULATOR | 100 | 0.01 | - | 0.5+.2=.7 |
| 5 | ACCUMULATOR/ BLADDER | 251 | 1.77 | - | 0.5+.4=.9 |
| 6 | WATER SEPARATOR | 100 | 1.20 | 254 | 0.2+.2=.4 |
| 7 | TRANSMISSION | 251 | 1.50 | - | 0.5+.1=.6 |
| 8 | FLUIDIC SWITCH | 251 | 1.61 | - | 1.0+.1=1.1 |
| 9 | FILTER | 251 | 0.16 | - | 0.1+.2=.3 |
| 10 | ELECTRIC SWITCH | 252 | 5.74 | - | 0.2+.1=.3 |
| 11 | PRESSURE REGULATOR | 100 | 2.94 | 254 | 0.1+.1=.2 |
| 12 | VALVE (GN ₂) | 100 | 0.72 | 254 | 0.1+.2=.3 |
| 13 | CONTROLLER | 251 | 2.5 | 254 | 0.1+.3=.4 |
| 14 | HIGH FREQUENCY CONTROLLER | - | ÜNK | - | UNK |
| 15 | ELECTROACOUSTIC TRANSDUCER | 252 | 86.2 | 254 | 0.1+.2=.3 |
| 16 | HEAT EXCHANGER | 251 | 0.23 | 254 | 0.2+.5=.7 |
| 17 | HEATER-DC | 251 | 1.0 | • | 0.2+.1=.3 |
| 18 | BLOWER-AIR | 251 | 10.89 | 254 | 0.2+.1=.3 |
| 19 | CONTROLLER/ TIMER | 251 | 2.5 | 254 | 0.1+.3=.4 |
| 20 | THERMAL STORAGE UNIT (WAX) | 251 | 0.23 | - | 0.2+.5=.7 |
| 21 | DESICCANT CANISTER | 251 | 0.21 | - | 0.2+.5=.7 |
| 22 | CHECK VALVE | 251 | 0.312 | - | 0.1+.2=.3 |
| 23 | MANUAL VALVE | 251 | 0.776 | - | 0.1+.2=.3 |
| 24 | TEMPERATURE CONTROL VALVE | 251 | 7.183 | - | 0.1+.2=.3 |
| _} 25 | RELIEF VALVE | 251 | 0.312 | • ` | 0.1+.2=.3 |
| 26 | RF GENERATOR (MAGNETON TUBE) | | UNK | | UNK |
| 27 | ACTUATOR | 252 | .024 | | 0,2+.5=.7 |
| 28 | PRESSURE SWITCH | 251 | 3.57 | - | 0.1+.2=.3 |

SECTION 2
TECHNICAL DATA

Ü

D2-H356E4

HABITABILITY SUBSYSTEM 1.0 Food Management

APPLIANCE FUNCTIONS CONSIDERED

- 1.1.1 Ambient Food Storage
- 1.1.2 Refrigerated Food Storage
- 1.1.3 Frozen Food Storage
- 1.2.2 Food Warming
- 1.3.1 Dishwasher/Dryer Combination
- 1.3.2 Dishwasher/Dryer w/Dishes

DESCRIPTION

J

The food management subsystem supplies all of the necessary functions for the storage and preparation of foods as well as the equipment required for the galley cleanup. Disposable dishes and utensils were considered as alternates to cleanup equipment. The three types of food storage were identified as ambient (dry or liquid), refrigerated, and frozen. The requirements for the food mix between these three categories are discussed later in this description.

Food preparation functions include rehydration of dry food and warming of frozen food. No considerations were made for the preparation of food mixes or cooking of food.

The cleanup equipment necessary to provide clean dishes and eating utensils for each crewmember for each meal was determined by first identifying the best mechanical cleaning systems and then comparing them against disposable dishes and utensils.

A large variety of spacecraft foods are available for crew consumption. These are typically divided into two major categories: wet (more than 5% moisture content) and dry (less than 5% moisture content). The dry food is considered to be shelf stable at ambient temperatures. The wet food is divided into three categories: (1) shelf stable at ambient temperature, (2) refrigerated, and (3) frozen. Obviously, a large variation in food mix could be chosen from these basic types. The Apollo wet/dry food mix was 20/80. For Skylab it was 30/70. The crew requirement for drinking water from the portable water system will vary depending on the amount of water in the food mix. Also, the vehicle weight/volume/power penalty will depend on the type of food storage used -ambient, refrigerated, and frozen. To do a detailed optimization of the food system was beyond the scope of this study. Many of the decisions regarding food types depend on crew preference and psychological factors rather than strict weight/volume/power penalties. Consequently, it was decided to perform all the trades of food storage appliances based on the food mix used for Skylab. The weight and volume of frozen, refrigerated, and ambient storage for Skylab is given in Table C2-1.

HABITABILITY SUBSYSTEM

()

1.0 Food Management (Continued)

TABLE C2-1

PLANAED SKYLAB FOOD WEIGHT AND VOLUME
(INCLUDING PACKAGING AND RESTRAINT) FOR 420 MAN-DAYS

| | Total | Food Size | | Food Size | Per Unit |
|-----------------|----------------------|--------------------------|-----------------------|----------------------|--------------------------|
| Food Type | Weight kg (1b) | Volume cum (cu ft) | Number of Units | Weight kg (1b) | Volume cum (cu ft) |
| Frozen | 121 (266) | 0.299 (10.56) | 5 | 24.1 (53.2) | 0.0598 (2.11) |
| Refrigerated | 24.1 (53.2) | 0.0598 (2.11) | 1 | 24.1 (53.2) | 0.0598 (2.11) |
| Ambient Storage | 955. (2106.) | 2.60 (91.7) | 11 | 87 (192.) | 0.236 (8.34) |

These are the initial launch values for a planned 420 man-days. These values were multiplied by 1080/420 to adjust for the 1080 man-days for Space Station assumed in this study. (NOTE: No contingency is accounted for in this ratio since the Skylab food weights already include the actual contingency used for the Skylab mission.) The resulting size required for Space Station food storage is shown in Table C2-2. The refrigerator locker size was adjusted slightly to be the same size as the freezers and, at the same time, correspond to the Skylab refrigerator size.

TABLE C2-2

REQUIRED SPACE STATION FOOD WEIGHT AND VOLUME
(INCLUDING PACKAGING AND RESTRAINT) FOR 1080 MAN-DAYS

| | Total | Food Size | Number | Actual | Assumed Foo | d Size Per Unit |
|------------------|----------------------|--------------------------|-----------------------------------|----------------------------------|----------------------|--------------------------|
| Food Type | Weight kg (1b) | Volume cum (cu ft) | of Skylab Units Required | Number of Units Assumed | We'ght ky (1b) | Volume cum (cu ft) |
| Frozen | 311. (685.) | 0.769 (27.16) | 12.87 | 13 | 23.9 (52.7) | 0.0592 (2.09) |
| Refrigerated | 62. (137.) | 0.154 (5.43) | 2.57 | 3 | 23.9 (52.7) | 0.0592 (2.09) |
| Ambinent Storage | 2459. (5420.) | 6.68 (236.) | 28.3. | 28 | 88. (194.) | 0.239 (8.43) |

HABITABILITY SUBSYSTEM

1.0 Food Management (Continued)

A number of different refrigeration systems were discussed in the literature reviewed including dry ice, water sublimation, cryogenic storage, precooled heat sink, vapor compression, space radiator, thermoelectric, and air-cycle turbine/compressor. These concepts were all reviewed for mission of 84 to 2250 man-days, and only two (space radiator and thermoelectric) were found to be practical for space missions. Consequently, only the space radiator and thermoelectric concepts were examined in this study; and also the air-cycle turbine/compressor was included for comparison since it represents a typical commercial aircraft system. Other types of refrigeration systems are available, such as Stirling and Brayton cycles.

| HABITABILITY SUBSYSTEM | 1.0 Food Mana | gement | | |
|--|--------------------------|-------------------|-------------|--------|
| HABITABILITY FUNCTION | 1.1 Food Stor | age | | |
| APPLIANCE FUNCTION | 1.1.1 Ambient | Food Statema | | |
| NUMBER OF CONCEPTS CONSID | DERFO 2 | | | |
| ASSUMPTIONS | | , | | |
| The ambient food storage food management descripti | capacity assumed on): | in this study was | as follow | s (see |
| Number of units | | 28 | | |
| Individual unit packaged | food weight | 88.0 kg | 194 | lbs |
| Individual unit packaged | food volume | 0.239 cu m | 8.43 | cu ft |
| Total packaged food weigh | t | 2459.0 kg | 5420 | lbs. |
| Total mastaged food volum | / s | 6 69 cu m | 236 | cu ft |

| | 5 | , 231914W2W93 | 440 7.00 | FLOS REQUIRENENTS | 46475 | Simola lengles | ڊ وو | 4 T S | נוני הי | ELEC PRY RESUTS | 4746 | 81/462 #60415 | , L | 109554 | A Taons Je |
|--|---|------------------------------|-------------|-------------------|-------|---|---------|---|---|--|---|---|--------------|--------|---------------------------------------|
| 350/588 *********************************** | | 6750 6750 6756 8756 | 2072 | | 144 | 7 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | * ** | i in | | | 1911 1911 | VOLUME AVAIL INDER | 7. | | # # # # # # # # # # # # # # # # # # # |
| 000 | | | | | : | - | - | :: | •• | ••• | 1204.01 | 10.51 | - | 0 | |
| 0000 | | | ; ; ; | | | - | - | | ••• | 0.0 | 20.01 | 1246.003 | - | • | • • • |
| 374 3 4 918 3 4 918 40 918 40 | | | ORIGIN. | | • | | | CABIN AIR CABIN AIR CAYGEN COCLING WATER WATER HITROSEN HITROSEN WATER | 8 | (CIRCULATED). (LOST) (LOST) (CISCULATED). (LOST) (CIRCULATED). (CIRCULATED). (CIRCULATED). (CIRCULATED). | | EC (FT ³ /MIN) (LB/HT) (LB/HA) (LB/HA) (LB/HA) (LB/HA) (LB/HA) (LB/HA) | E | | |
| | | S OTALES | AL PAGE IS | | | | 5333 | (**) AVAILABLE AVAILABLE STATE OF THE ART SCYE DEVELOPHENT EXTENSIVE DEV. R | (**)&"AILABLE AVAILAGLE STATE OF THE ART SCY'E DE YELOPHENT REQUIRED EXTENSIVE DEY, REC IED | EQUIRED | 0-25x 0-25x 25-50z 50-75x 75-100x | 7 ATOR 20 22 22 22 22 22 22 22 22 22 22 22 22 2 | | | |

20 PAGE 1. CONCEPT NUMBER

Ambient Food Storage (Space Station) Concept Trade C2-6

| | | | • | ł | | , | | 1 | L- ' . | . 110 | | · T | | | | | | | | | | | |
|--------|---|------------|--|------------|---|----------|------------------|----------|--------|-------|----------|--------|--------|------------|-----|--------|--------|----------|--------|-------|-----|---|--------|
| | | | 1 | | | | | | | , | | | | | | | | | | | | | |
| | | | | • | | | | | | | | | | | | | | | | | | | |
| į. | | | ! | | | : | | | | • | | | | | | | | | | | | | |
| | | | : : | 1 | | ! | | | | ı | | | | | | | | | | • | | | |
| 1 | | | , | ; | | ; | | | | , | | | | | | | | | | | | | |
| | | | : | | • | : | | | | | | | | | | | | | | | | | |
| | | | 1 | | 1 | | | | | ı | | | | | | | | | | 5 | | | |
| | | | i | | | 1 | | | | | | | | | | | | | | (| 1 | | |
| | | | j | i | | i · | | | | | | | 1 | | | | • | | | | | | |
| İ | • | | | | | ! ! | : | | | ļ | | | | ı | | | 1 | | 1 | : | ! | • | + |
| i i | • | | | . NO I F | | | | | | | | i | | | • | | | : | | 1 | 1 | | |
| • | | | ! | STA | | | | | | | | (| RÍ | GIN | AT. | DA | 100 | - TrCs | | i | | | |
| • | • | | 1 | PACE | | • | : | | , | | | (|)F | GIN POO | R | QU. | ALI | TY | • | | | | |
| | | | | . S | | y U | 1 | | | , | | ; | 3 | , | | | | l | | ! | : | | |
| : | 1 | | | STORAG | | 2 | i | ı | : | , | | | 1 | • | | | : : | t • | 1 | : | i | 1 | ! |
| ; | : | | | : | | 3 | | | | • | | 1 | ! | 1 | | l | | ! : | ! | i . | i | , | ! |
| | | | 2 4 0 2 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | F 000 | 1 | | į | 1 | ! | | | į | 1 | | | | | | | 1 | | | |
| | | | | I E N I | | ` . ~ | . 78 | 28 | 69. | | , | |) ! | : | | | İ | , I | | | İ | } | : |
| | | | TOH | N V | 1 | 1 | E 2 | 91 _ 1 | 0 | | : | 1 | ļ | - | | | | <u> </u> | | | 1 | ! | |
| ı | | | 18/8 13/8 00 | • | | | 969 | 90.5 | 37.50 | • | ı | | ļ | | | | | İ | | | | İ | : ! |
| , | | RSI | NT (LB/ (LB/ •7103 | .7. | : | Ņ | 510 | 1 | | ı | : | | | | | | | ! | | İ | | | |
| : | | .49 YEARSI | OOLA Leak j | (12/06/24) | | 715 | | | 100 | | | ; ; | 1 | 1 | | | | <u> </u> | | | | | ; ; |
| ; | | | TO CO | • . | | × 2 | 000 | 200 | 8 | , | | | | • | | | | ! | | | ! | 1 | |
| | | 180.0 | | HATRIX | | MAK | 206.02 | 000.01 | 100.00 | | | : | | İ | | | | | | | ; | 1 | |
| | | 180 | Y - DIRECT Y - CABIN (LBS/RATT) | ¥ | 1 | | • | i | • | • | | | | | | ! ! | | | ! ! | | 1 | | * |
| : | | 5 |) - - | ET 10 | | MIN | 000 | 000 | •00000 | 1 | : | : | | | | | | | | | 1 | İ | Ì |
| , | | 0415 | PENALTY - 01 L PENALTY - 01 PENALTY - CA | SELECTION | | = \$ | 20.600 | 00000 | | | ! ; ! | • | | | | ł | • | į | 1 | | 1 | 1 | |
| | , | 70 6 | 2 4 4 2 4 4 | | | ~ | W | | ; • | • | 1 | ! | | 1 | | ! | | | | | ; | | |
| 1 | | RUNGER OF | TARRALL Tarrall Toerrall | i | | FACTOR | WEIGHT VOLUME | TOTAL PT | RATING | 1 | 1 | | | | | • | | | | | ļ | İ | |
| | ; | 1 | | | : | | ; # > i | غَة ا | ; | i | | İ | | | | İ | | | 1: | 2 = 1 | , , | | |

0073520

Ċ

Ċ

 \mathbf{C}

()

0

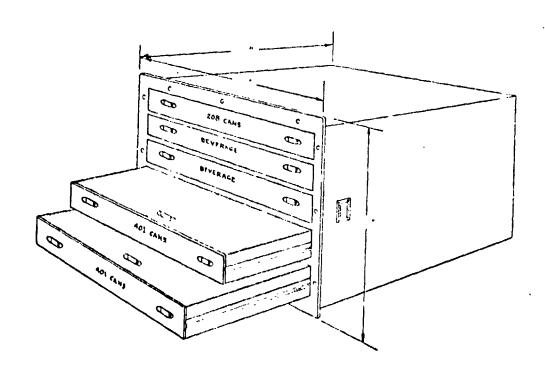
| | | | D2-118561-4 | |
|------------|---|---|---------------------------------------|----------------------------------|
| : . : . | SELECTION MATPIX • • • • AMBIENT FOOD STORAGE (SPACE STATION) FACTOR VALUE VALUE PTS 1 2 | #EIGHT 20.6CD 206.00 15 .00 13.50 VOLUME 268.00 371.00 10 .00 2.78 00 DEV COST .00000 10.00 15.00 .00 16.28 | RATING .000000 100.00 100 37.50 40.69 | ORIGINAL PAGE IS OR POOR QUALITY |

0073527 4

| SPACECRAFT Space Station | intel [®] Company and the second secon | |
|--------------------------------|--|--|
| HABITABILITY SUBSYSTEM Food Ma | anagement HABITABILITY FUNCTION Food Storage | |
| APPLIANCE FUNCTION Ambient | Food Storage | |
| APPLIANCE CONCEPT NO./TITLE | 1/Rigid Container | |
| INDEX NO. 1.1.1.1 | REF. NO. 177 | |
| | | |

DESCRIPTION

In this concept, ambient food is contained in a rigid box-like container with shelves to retain the food. A structural weight of 26.3 kg per kg of food capacity was used from Reference 177. Volume was estimated on the basis of each individual storage locker being cubical in shape with 5.08 cm (2.0 inch) effective wall thickness on all sides.



O

| | | ELEC | TRICAL | POWER | REQUIR | EMENTS | • |
|--------------|-------|---------------------------|------------------------------|----------------------------|---|----------------------|--|
| | | •, •• • • | | C POWE | | D (| C POWER |
| CCMPONENT // | (REF) | USE TIME CYCLE (HR) | | ③ AVERAGE (WATTS) | DEMAND (WATT-HP/ CYCLE) (DX(3) | ⑤ PEAK (WATTS) | 6 DEF AVERAGE (WATT (WATTS) (1) |
| | | | | | | | |
| | | | | | | | FORT CANADANA PROPERTY CONTRACTOR |
| | | | | | | | |
| • | | | MAXIMUM | | TOTAL | MAXIMUM | TOT |
| | | | | | | | |
| | ī | OTAL | WAT: (BTU/HR) | WATT | (BTU/HR) | WATT (BTU/HR) | WATT (BTU/H |
| | | | | • | | | |
| | · | | Q P E R A T I O | NAL PE | NALTIE | <u>s</u> | |
| • | RCE | HE (BTU/I | THERMAL AT LEAK IR/CYCLE) (B | TO COOLANT TU/HR/CYCLE) | ELECTRICA (PK WATTS/C | | |
| SOUF | 11/ A | | | | | | |
| SOUF. | 2/_4 | | | | | | |
| Sour | //,4 | | | | | | |

| CONCEPT_1/1'.15 | APPETANCE CONCER | | | | INDEX NUMBER | <u> </u> |
|--|--------------------------------------|----------------------------------|------------------------------|--|--|------------------------------------|
| COMPONENT J. J. L. L. J. J. J. L. L. J. V. L. L. L. L. L. L. L. L. L. L. L. L. L. | EIXED W | У ———— | WEIGHT (185) | QUIRENEN | , | VOLUME (FT') |
| | | | | | | |
| | | | | | | |
| | TOTAL SOLID EXP | 97 ENDABLE | KG (LBS) . W 1/V O L | REQUIRE | | (57) (H³) |
| TYPE | • | WT/UNIT (REF) (PKG. WT/UNIT)(REI | WT/CYC | LE VOL/0 (PKG.V | WUNIT (REF) OL/UNIT)(REF) (FT ³) | () x (4) (1) x (4) (1) x (4) |
| | | Σ | TOTAL WIT | CYCLE | Σ③ | TOTAL VOL/ČYCL |
| | LES/DAY DAY | S/MĪSSION X _ | TOT.WT/CYCL (LB) | | Ki | (FT3) |
| NTSSTON CYCI | LES/DAY DAY | S/HISSION X | TOT.VOL/CYC | LE - | Н | (F13). |
| туре | G A S/L I Q U I D AMT. USED/CY((LB |) | ABLES R O RECOVERY FACTOR | EQUIREM (3) AMT.RECOVERI (1) X (1) (LB |) CD/CYCLE | . AMT LOST/CYCLE () - (3) (LB) |
| | ΣΦ | | | | Σ : 0 | |
| OTAL WT NISSION | 70AY —— X — DAYS/MISS | TOTAL TOTAL 1 OS | STICYCLE - | (LB) (I | • [| KS (LB) |

ORIGINAL PAGE IS

Total ob

| SPACECRAFT Space Station | • | | | | | | | |
|---|------------------------------------|--|--|--|--|--|--|--|
| Food MABITABILITY SUBSYSTEM Management | HABITABILITY FUNCTION Food Storage | | | | | | | |
| APPLIANCE FUNCTION Ambient Food Storage | | | | | | | | |
| APPLIANCE CONCEPT NO./TITLE 2/1 | lexible Container | | | | | | | |
| INDEX NO. 1.1.1.2 | REF. NO177 | | | | | | | |

DESCRIPTION

In this concept, an elastic netting material is used to retain the ambient food within retractable guides. Structural weight is assumed, according to Reference 177, to be 10 percent of the weight for the rigid concept. Volume was estimated on the basis of each individual storage locker being cubical in shape with 1.27 cm (0.5 inch) effective wall thickness on all sides.

| | <u>E</u> | TRICAL | <u> </u> | REQUIRE | MENIS | | |
|---|-------------------------------------|---------------------------------------|--------------------------------|---|---|-------------|-------------------------|
| • | _ | | AC POW | E.R. | D.0 | C POWE | R |
| | ire tire | | (3) | (4) DEMAND (WATT-HR) | (3) | <u>(6)</u> | (/) DEMAN H-TTAW) |
| OMPONENT (REF) | CYCLE (HR) | PEAK (WATTS) | AVERAGE | CYCLE) (1) x (3) | PEAK | AVERAGE | CYCLE |
| M/A (REP) | (ne) | (#///12) | (WATTS) | (I) v (3) | (WATTS) | (WATTS) | (1) x (|
| | | | | | | | |
| | | | | | | | |
| gridde o Williamsky greek op de de de de de de de de de de de de de | | · · · · · · · · · · · · · · · · · · · | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | MUMIXAM | | TOTAL | MUMIXAM | | 7074 |
| · | | rio Irion | | TOTAL | MAXINUM | • | ATOT |
| • | | • | | | | | |
| SOURCE | | THERMA LATENT (BTU/HR) | SE | LREMENTS ENSIBLE STU/HR) | HEAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| 11/3 | | | | | | | |
| an an an an an an an an an an an an an a | | | | | | | |
| | · ······ · · · · · · · · | , | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | • | | |
| | TOTAL | | | | | | - |
| | | WATT (BTU/ | IR) WATT | (BTU/HR) | WATT (BTU/HR) | WAT | T (BTU/HR) |
| • | | | | | | | |
| • | | | | | | | |
| | | • | | | | | |
| • | | | | | | | |
| | | OPERAL | IONAL P | ENALTIES | <u>i</u> | | |
| | NE | THER! | MAL TO COOLANT | ELECTRICAL | . WE I GHT | ľ | VOLUME |
| SOURCE | (BTU/II | R/CYCLE) | (BTU/HR/CYCLE) | (PK WATTS/CY | CLE) (LB/MISSI | ION) (FT | 3/MISSION |
| M/Δ | | | | | | | • |
| | | | | • | | | |
| | | | * | • | | | |
| | | | | • | | | |
| | | | | | - | | |
| | | | | · | | | |
| | | | | | | | |
| Ţ | DTAL | rs/cvill | MATTS/CYCLE/ (BTU/HK/CYCLE/ | | | | |

| COMPONENT, | ΕĮχį | (REF) | E " 17 L " 1 | WEIGHT (LBS) | ř d n í š ř w i | # * # | VOLUME |
|-------------------------------|--------------------------------|---------------------------------------|--|------------------------------|---------------------------------------|--|--|
| Tetil the | -44 | Contradiction | happingsign grandeline | (C65) | | , | (111) 26: |
| | 4111.4 | / | | - | | | |
| | <u></u> | | | | | | |
| | | | - | | • | | |
| | | | t desired to the con- | | | | |
| | | | | | | ga geren haan aan deriganga dan | |
| GINAL PAGE IS POOR QUALITY | , | TOTAL | | KG (LBS) | <u></u> | 7.5 | 9 (2.6) N ³ (FT ³) |
| | \$ <u>0</u> L <u>I</u> D | EXPENI | | H T/V O L | REQUIR | | |
| TYPE | UNITS/CYCLE | WT, (PKG | /UNIT (REF) .WI/UNIT)(PE (LB) | () WT/C F) () Y (LI | 3) YCLE VC (2) (PKI | 4 L/UNIT (REF) .VGL/UNIT)(REF (FT') |) (1 1 .) (1 2 .) (1 2 .) (1 1 .) |
| , | | | | | | | |
| | ****************************** | | anne de servicio de la como de la | | | | |
| | **** | | | | | | |
| | • | | Σ | TOTAL W | /¿ŶĠĬĘ | Σ (§ |) TOTAL VOLVENC |
| TOTAL WT | LSZDAY | DAYS/MI | SSION X | 101.417646 | * | | KG (LB) |
| | | | | (LE) | · · · · · · · · · · · · · · · · · · · | ļ | |
| TOTAL VOL MISSION CYCLE | isyday X | DAYS/MI | SSION X | 101.Vol.\C\ | W.F. | L | M ₂ (F1 ₃) |
| , | <u>G A S/L 1</u> | Q <u>ulb</u> j | EXPEND: | ABLES | <u>R E Q U I B E</u> | M E N T S | |
| TYPE H | AMT | USED/CYCLE(I | REF) | RECOVERY FACTOR | AMT , RECOV | O EPF6/CYCLE X O LB) | AMT LOST/CYCL () - () (LB) |
| | | | | | | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | | |
| | ΣΟ | | | | | ΣΘ | |

D2-118561-4

| HABITABILITY SUBSYSTEM | 1.0 Food Management | | |
|--|--|--|--|
| HABITABILITY FUNCTION | 1.1 Storage | | |
| APPLIANCE FUNCTION | 1.1.2 Refrigerated Stora | ge | |
| NUMBER OF CONCEPTS CONSID | ERED3 | | |
| ASSUMPTIONS: The Space : | Station refrigeration capa management description): | city assumed in | this study |
| Number of units: Individual unit package Individual unit package Total packaged food we Total packaged food vo | ed food volume Ight | 3 23.9 kg 0.0592 cu m 71.6 kg 0.177 cu m | (52.7 lbs) (2.09 cu ft) (158. lbs) (6.27 cu ft) |

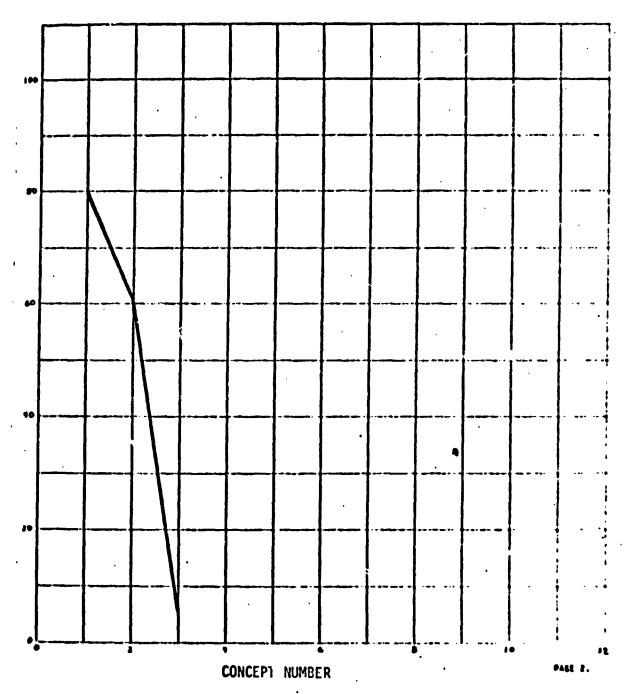
Refrigerator box insulation thickness was assumed to be 10.16 cm (4.0 inch) for all concepts.

| ### ### ############################## | AVG PRR AVG |
|--|--|
| 165 - DTG C - 18775 - | 6 PBR |
| 161 10CG F) (BTU/HR) (BTU/HR) -84 TTS- 161 10CG F) (BTU/HR) (BTU/HR) -84 TTS- 161 10CG F) (BTU/HR) -84 TTS- 161 10CG F) (BTU/HR) -84 TTS- 161 10CG F) (BTU/HR) -84 FTS- 161 10CG F) (BTU/HR) -84 FTS- 161 10CG F) (BTU/HR) -84 FTS- 161 10CG F) | 0 134.1 .42 4 6 1 1 1 1 6 6 1 6 6 1 6 6 1 1 1 1 1 1 |
| 0.01 (0.01) (179.) (0.01) (0.0 | 0 (300.01 (22.00) 0 (300.01 (22.00) 0 (337.0 (25.10) 0 (335.7 2.04 3 70 0 (520.01 (72.00) |
| .000 | 136.1 .62 -1 0 1 1300.0) 1 22.00) 1 131.0 .71 2 25 1 337.0) 1 25.10] 2 25 1 520.0) 1 72.00) 1 |
| .000 .000 .000 .000 .000 .000 | 152.9 .71 2 25 (337.0) (25.10) 2 76 (520.0) (72.00) (|
| .000 .000 .000 .000 | 235.7 25.101 25.101 25.25.7 25.001 1 72.001 1 72.001 |
| 2041- 435- 11000 | (\$20.0) (72.00) |
| | |
| | |
| 1 - CABIN AIR 2 - CASIN AIR 3 - ONVER 4 - COLING WATER 5 - WATER 6 - NITPOSEN 7 - NITPOSEN 8 - FREDN 9 - WATER | (CIRCULATED), LITEES/SEC (FT/RIS) (LOST) |
| IGIN POO | 1503(***) |
| A A AVAILABLE | `A |
| 3 | 0-25¢ |
| (2) | REQUIRED |
| (9) | EXTENSIVE DEV. REQUIRED 75-1635 |

Ü

APPLIANCE
CONCEPT
NO. ONCEPT NAME

SPACE RADIATOR
THERMOLLECTRIC
AIR CYCLE-TURBINE/COMPRESSOR



Refrigerated Food Storage (Space Station) Concept Trade

| SELECTION MATRIX REPRIGENTED FOOD STORAGE (SPACE STATION) SELECTION MATRIX REPRIGENTED FOOD STORAGE (SPACE STATION) STORE | SELECTION HAT | M 0000 4 7 9 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 9 N N N N N N N N N N N N N N N N N N N | | 0 | FOOD STORAGE (SPACE ST | |
|--|---------------|--|---|-----------|---|---|-------------------------|
| ORIGINAL PAGE 18 OF ROOM OF PROOF OF PR | | AAA A LUE E CO CO CO CO CO CO CO CO CO CO CO CO CO | | | 04 m 4 0 4 0 4 V | 2 C O N C E C O N C E C O O O O O O O O O O O O O O O O O | |
| ORIGINAL PAGE M PROOR QUALITY 815 2100 25 25 20 20 20 20 20 20 20 20 20 20 20 20 20 | | 20.00 2.000 2.000 35.41 | 1 1 1 1 1 | 1 ! ! ! ! | 0 7 - 7 0 4 0 7 N | 00. 00. 00. 5.00 5.00 | |
| ORIGINAL PAGE IN ORIGIN | 300.00 | 2.000 57.61 3671 | | | | 00.5 00.0 00.0 00.0 | |
| ORIGINAL PAGE NO PROOF 100 00:00: 5:10: 5:00 00:00: 00:00: 00:00: 00:00: 00:00: 00:00: | 22.000 | 3671 | | | 6 9 0 5 7 | 00°5 00°5 00°5 | |
| ORIGINALI PAGE PO PROPERTO CONTROL CON | .23321 | , | 1 1 | | | 8 • 00 8 • 00 8 • 00 | |
| ORIGINAL PAGE 100000. ORIGINAL PAGE 100000. ORIGINAL PAGE 100000. ORIGINAL PAGE 100000. | 00000 | 0000 | 1 1 | 1 | | 00.5 | D2 |
| ORIGINAL PAGE IN OCCUPANTION OF POOR QUALITY | 00000 | 0000 | ١ | | | | -118 |
| | | 00.00 | | | | 00.5 | 856L- |
| RIGINAL PAGE ES POOR QUALITY | | | | | | O O | <i>x</i> ₁ - |
| VAL PAGE IS OR QUALITY? | | | | | | RIGII F Po | |
| PAGE 78 RULLIVY | | | | | | VAL: OR | |
| | | | | | | PAG QUAI | |
| | | | | | | E IS | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| #### ################################# | 1 | | | 36 | SENSITIVIT _y ANALYSIS | |
|--|--|----------|--------|----------------|--|----------|
| 1.2 CONCEPT 1.2 CONCEP | 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:55 40:47 5:18 77:57 5:19 6:18 77:57 6:18 6:18 77:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 78:58 6:18 6:18 | | SINGLE | SELECTIONS FOR | EACH CONCEPT AFTER INCREASING PARAMETER WEIGHTING FACTOR BY | |
| 77.57 40.47 5:48 77.57 40.47 5:48 77.57 40.47 5:48 77.57 40.47 5:48 77.57 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.47 5:48 77.59 40.45 5:40 80.72 5.40 | 70.57 40.47 5.00 14.15 5.12 15.15 5.12 16.15 5.12 17.15 5.12 | | i | | ONCEP | |
| 74.55 58.41 5-11 74.55 58.41 5-11 74.55 58.41 5-11 74.15 58.41 5-11 74.15 58.42 58.42 58.42 74.15 58.42 74.15 58.42 74 | 1.15 51.41 | | - | 2 | | |
| 1, 1, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, | 1,155 54,01 51,1 1,2 | HORMAL | ٠ 🗭 | • | | C: O |
| 1. 1. 1. 1. 1. 1. 1. 1. | SENSITIUIT ANALYSIS SENSITIUIT ANALYSIS SINGLE SELECTION PARANTER PEIGHTHIG FACTOR BY -50.8 1. 2 C.O.N. C.E.P. T 1. 2 C.O.N. C.E.P. T 1. 2 C.O.N. C.E.P. T 1. 2 C.O.N. C.E.P. T 1. 3 C.O.N. C.E.P. T 1. 4 S. 19 6.45 1. 4 S. 19 6.45 1. 5 S. 19 6.45 1. 5 S. 19 6.45 1. 6 S. 19 6.45 1. 7 S. 5. 60.45 1. 7 S. 5. 60.45 1. 8 S. 19 6.45 1. | PEIGHT | i | 58.61 | | ig P |
| Total Salar Sala | SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE_SELECTION ARABETER REGARDING_FEQ. 8. 1 | PORER | 1 | 60.92 | | IOO |
| SENSITELITY_ANALYSIS SENSITELITY_ANALYSIS SINGLE_SCLECTION PARAMETER WIGHTING_EXCION 87 = 50.3 SINGLE_SCLECTION PARAMETER WIGHTING_EXCION 87 = 50.3 TY-ST 40.47 5-08 1 2 3 C.O.M.C.E.P.T TY-ST 40.47 5-08 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 80.37 42.05 6-06 | ### 194.15 # | ERMAL | ě. | 58.99 | | L I |
| SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE_SCLECTION PARMETER REIGHTING_RCIOR OY =50 g CONCEPT AFTER INCRESSING SINGLE_SCLECTION PARMETER REIGHTING_RCIOR OY =50 g CONCEPT AFTER INCRESSING SINGLE_SCLECTION PARMETER REIGHTING_RCIOR OY =50 g CONCEPT AFTER INCRESSING | SENSITIUITY_ANALYSIS SENSITIUITY_ANALYSIS SINGLE_SCLECTION PARAMETER REGHTING_FACTOR_SY_SO_R (aASEO ON 1000 S MAX POINTS) 1 2 3 C O N C E P T T7.57 60.77 5.08 1 2 3.0 T7.55 60.32 6.15 57.55 60.32 6.15 | INTERC | | 59.37 | | AC MA |
| SENSITIVITY_ANALYSIS SINGLE_SELECTION PARAMETER REGATING BY =50 g Cased on 100 g max Points! 2 | SENSITIVITY_ANALYSIS SINGLE_SELECTION PARAMETER WEIGHTING FACTOR BY =50 & cased on 100 & max Points) 1 | 1503-4 | 1 1 | 60.97 | | |
| SINGLE SCLECTION PARAMETER INCREASING (GASED ON 100 & MAX POINTS) 1 2 3 C.O.N.C.E.P.T 77.657 40.67 5.08 43.17 43.19 6.45 63.17 43.19 6.45 77.657 60.39 6.25 80.20 60.39 6.25 80.30 60.39 6.25 80.30 60.39 6.25 80.30 60.39 6.25 80.30 60.39 6.25 80.30 60.39 6.25 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 80.30 6.00 | SINGLE SELECTION PARAMETER HEIGHTING FACTOR BY =50 % (BASED ON 100 % HAX POINTS) 1 2 3 C 0 N C E P T 77.57 60.67 5.86 80.20 60.30 6.45 80.20 60.30 6.45 80.37 62.45 6.06 80.37 62.45 6.06 80.37 62.45 6.06 80.32 64.45 | | | 38 | ENSITLYITY_ANALYSIS | |
| 1 2 3 79.57 60.67 5.88 63.17 63.14 6.45 77.63 57.03 6.45 80.20 60.39 6.25 77.73 57.16 6.45 80.78 62.45 6.06 80.37 62.05 6.06 77.59 60.32 6.45 | 1 2 3 70.57 60.67 5.88 63.17 63.14 6.45 77.63 57.03 6.45 80.20 60.39 6.25 77.73 57.16 6.45 80.37 62.05 6.06 80.37 62.05 6.06 77.59 60.32 6.45 | | SINGLE | SELECTIONS FOR | EACH CONCEPT AFTER INCREASING PARAMETER WEIGHTING FACTOR BY ON 100 8 MAX POINTS! | |
| 79.57 60.67 5.88 63.17 63.19 6.45 77.63 57.03 6.45 80.20 60.39 6.25 80.78 62.45 6.06 80.37 62.05 6.06 78.95 62.51 3.03 77.59 60.32 6.45 | 79.57 60.67 5.88 63.17 63.19 6.45 77.63 57.03 6.45 80.20 60.39 6.25 77.73 57.16 6.45 80.37 62.45 6.06 76.95 62.51 3.03 77.59 60.32 6.45 | | | | 2 0 | |
| 74.57 60.67 63.17 63.14 77.63 57.03 80.20 60.39 77.73 57.16 80.37 62.05 76.95 62.45 77.59 60.32 | 79.57 60.67 63.17 63.14 77.63 57.03 80.20 60.39 77.73 57.16 80.37 62.05 78.95 62.51 77.59 60.32 | | 1 | .~ | 8 | |
| 83.17 63.14 77.63 57.03 80.20 60.39 77.73 57.16 80.78 62.45 80.37 62.05 76.95 62.51 | 63.17 63.14 77.63 57.03 80.20 60.39 77.73 57.16 80.78 62.45 80.37 62.05 76.95 62.51 | MORMAL | • • | • | • | |
| 77.63 - 57.63 80.20 - 60.39 77.73 - 57.16 80.37 - 62.45 76.95 - 62.51 77.59 - 60.32 | 77.63 57.03 80.20 60.39 77.73 57.16 80.78 62.95 76.95 62.95 77.59 60.32 | ME 1 GHT | 13.17 | 63.14 | Sign of the sign o | |
| 80.78 62.45 80.37 62.05 78.95 62.51 77.59 60.32 | 00.76 62.45 60.37 62.05 76.95 62.51 77.59 60.32 | DEF. | 80.20 | 60.39 | | |
| 77.59 60.32 | 77.59 60.32 | EL LABOT | 90.78 | 62.45 | 1 | |
| C05T 77.59 60a32 | COST 77.59 60.32 | INTENC_ | 76.95 | 62.63 | 1 | |
| | | | 77.59 | | 9.15 | |

| I | DAYS = 18 | 6. 1 0 | YEARS | | | | | |
|-----------|--------------|-------------------|-------|----------------|---------------------------------------|-------------------------------|------------|-----|
| THERMAL P | PENALTY = DI | DIRECT TO COOLANT | 1 | (LB/BTUH) | | 540 280 | | |
| | (185 | AATT TYPE | | .7100 .5910 | | | | |
| | | | • | | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | RIGERATED FOOD STORAGE (SPACE | STATION | |
| | | | 7 | | | | | |
| | | | | | | | | |
| FACTOR | VALUE | VALUE | PTS | _ | 2 | 6 | | |
| BEIGHT | 300.00 | 520.00 | 21 | 6.35 | 5.28 | 00. | | |
| VOLUME | 22.000 | 72.000 | : | *6.9 | . 40 1 | 00. | | |
| THERMAL | .9.6660 | .94050 | | 2.77 | 61. | 00. | | |
| MAINTENC | 00000 | 1,0000 | 1 | 5.00 | | 5.00 | OI OI | |
| DEV COST | 00000 | 70.000 | 85 | 15.00_ | 51.67 | 5.00 | e Gi | |
| RATING | .00000 | 100.00 | 100 | 80.50 | 60.09 | 5.88 | VAI OR | 556 |
| | | | | | | | , P. QU | |
| | | | | | | | AGR ALI | |
| | | | | | | | IS TY | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | • |
| | | | | | | | | |
| | | | | | | | | , |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| | | SINGLE | RATING FOR | TOR EACH CONCEPT ATTER SON PARAMETER WEIGHTING SED ON 100 & HAX POINTS | INCREASING -FACTOR BY SO S | | |
|--|----------------------|---------|-------------------------------|--|-------------------------------|--|-----|
| 1 2 3 3 4 4 4 4 4 4 4 4 | | - | | | | | |
| STANTING TOR EACH CONCEPT ATTER INCREASING STANTING TORSEST ATTER INCREASING S | | - | 7 | | | | |
| SENSITY IT TANALYSIS SENSITY IT TANALYSIS SINGLE SELECTION OF LICE FOR FIGHTING AND STATEMENT OF THE SENSITY | NORMAL | 80.50 | 60.79 | 20.00 | | | |
| SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE SELECTION PARAMETER REIGHTING FACTOR DL. SG. 8 10.20 40.77 5.00 10.20 40.75 5.00 10.20 40.55 40.55 10.20 40.55 | FEIGHT | 77.41 | 58.71 | No.41 No.41 | | | |
| SINGLE STILL TO SANALYSIS SINGLE STILL ON CEPT AFFER INCRESSING. SINGLE STILL ON CEP | GLUME | 79.89 | 61.03 | 5.56 | | | |
| SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE_SELECTION PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGINTAL PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGENTING. SINGLE_SELECTION PARAHETER REGENTION PARAHETER REGENTION PARAHETER REGEN | RELIABLY | 79.79 | 59.16 | 5.71 | OR OI | | |
| SINGLE SELECTION PARAMETER INCREASING. SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY 450.8 1 | SAFETY | 91.04 | 59.05 | 8.57 | P | | |
| SENSITIVITY_ANALYSIS SINGLE SELECTION PARAMETER INCREASING. SINGLE SELECTION PARAMETER REIGHTING FACTOR BY ~50 8 1 2 3 C O N C E P T 80.50 60.77 5.88 81.20 63.24 6.45 78.74 62.51 6.05 81.34 62.77 6.04 81.34 62.77 6.04 81.34 62.77 6.04 78.42 60.45 6.45 | EV-CDST | -82.08- | -41.07 | 5 • 4 | OR | ************************************** | |
| SINGLE SELECTION TO RANKERS INCREASING. SINGLE SELECTION PARAKER REIGHTING FACTOR BY =50.8 SINGLE SELECTION PARAKER REIGHTING FACTOR BY =50.8 1 | | | | | Ø _L | 21 | • |
| SINGLE SELECTION PARAMETER RIGHTING FACTOR BY #50.8 SINGLE SELECTION PARAMETER REIGHTING FACTOR BY #50.8 (BASED ON 100 8 MAX POINTS) 1 | | | | | | GE | |
| SINGLE SELECTION PARAHETER WEIGHTING FACTOR BY =50.8 1 | | | | | | | o6i |
| 80.50 60.79 5.88 84.20 63.26 6.45 78.66 57.16 6.45 81.20 60.51 6.25 78.76 57.29 6.45 81.34 62.57 6.06 81.34 62.17 6.06 79.91 62.63 3.03 | | STRELE | ATING FI SELECTIC (BASE | FACH CONCEPT AFTER ARAHETER WEIGHTINGS MAX POINT | NG. BY.=50.\$ | | -4 |
| 84.20 60.79 84.20 63.26 78.66 57.16 91.20 60.51 78.76 57.29 81.34 62.37 79.91 62.43 78.62 60.45 | | - | | | | | |
| 84.20 63.26 78.66 57.16 81.20 60.51 78.76 57.29 81.34 62.17 79.91 62.63 78.62 60.45 | NORMAL | 60.50 | | 5.00 | | | |
| 81.20 60.51 78.76 57.29 81.26 62.51 81.34 62.17 79.91 62.63 78.62 60.45 | PEIGHT | 84,20 | 63,26 | 4 C C C | | | |
| 81.26 62.51 81.34 62.17 79.91 62.63 78.62 60.45 | OLUME | 91.20 | 60,51 | 6.25 | | | |
| 79.91 62.63 3 | RELIABOT MAINTENC | 81.26 | 62.51 | 6 • 0 6 • 0 4 | | | |
| | SAFETY DEV COST | 79.91 | 62.63 | 3-03 | | | |
| | | ! | ! | | | | |

THE PROPERTY OF THE PROPERTY OF THE PARTY OF

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 1.1.2-REFRIGERATORS

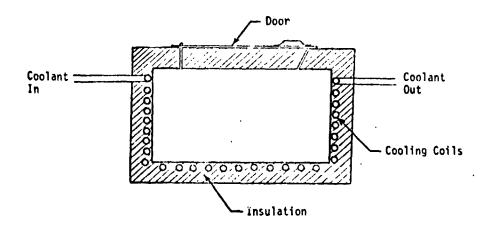
| | | | · | | |
|--------|------------------------------------|----------------|-------------------------------|------------------------------|---------------------------------------|
| | NUMBER OF SAFETY CRITICAL | 1 (5%) | 0 1 | 0 | |
| | | 0 | | | |
| | | 0 | | | |
| | | 0 | | | |
| S | | 0 | | | |
| E N T | | 0 | | | |
| N N | · | 0 | | | · · · · · · · · · · · · · · · · · · · |
| Σ Ω | | 0 | | | |
| ပ | | \bigcirc | | | |
| n 0 | | \bigcirc | | | |
| 2 | NJWJC. | | | | |
| B E | ВГОМЕ В СОИ180 ГГЕВ | | - 2 | | |
| N | « СХСНУИСЕ В НЕ УІ | | 2 1 | | |
| | NEVI COFENOID |) (6 | 2 1 | 1 | |
| | dWhq. | | I | 2 | |
| | 90 TOM | Θ | 2 2 | 2 | |
| | YPE | 2 | | · | • |
| | COMPONENT TYPE | APPLIANCE TYPE | SPACE " TOR THERMOELECTRIC | AIR CYCLE TURBINE/COMPRESSOR | |
| | | APPLIA | SPACE "THERMOEL! | AIR C | |

| SPACECRAFT Space Station | |
|---|--------------------------|
| HABITABILITY SUBSYSTEM Food Management HABITABILI | TY FUNCTION Food Storage |
| APPLIANCE FUNCTION Refrigerated Storage | |
| APPLIANCE CONCEPT NO./TITLE 1/space Radiator | |
| INDEX NO. 1.1.2.1 REF. NO. | 184, 255 |

DESCRIPTION: This concept is simply an insulated food storage box, with coolant from the spacecraft ECS radiators routed through tubing within the refrigerator walls. This concept was used for the Skylab refrigerator, which had the following size:

| • | WE | IGHT | VOLUM | E |
|--|--------------|-------------|-----------------|--------------|
| | kg | lb | cu m | cu ft |
| Food capacity (packaged and restrained) Total refrigerator (empty) | 24.1 45.8 | 53.2 101 | 0.0598 0.210 | 2.11 7.41 |

The Space Station refrigerators were sized proportional to the above Skylab data based on the refrigerator food capacity. The wall insulation was 10.16 cm (4.0 inch) thick. It was assumed that the radiator coolant would be of sufficiently low temperature for this concept to be feasible.



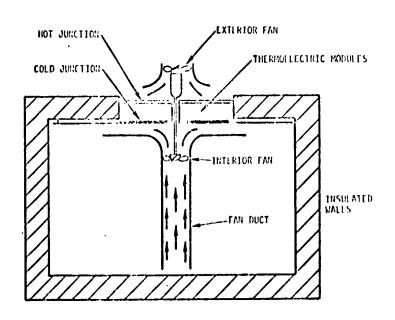
| CONCEPT | APPLIAT | NCE CONCEPT REQU. | IPENINTS AND | PENALTIES CALC | QLATIONS INDEX | NUMBER 1, 1, | |
|-----------------------------|--------------------------------|--------------------|--------------------------|-----------------------------|---------------------------------------|--------------------------------|--|
| Chillian. | 7-11-1 | | | | | | |
| | E T E C J | • | POWER | REQUIRE | | | _ |
| | (i) | A_(| | (| | | (i) |
| COMPONENT (RIF) | CYCLE (HR) | PEAK (WAT') | ③ AVERAGE (WATTS) | DETAND (WATT-HP/ CYCLE) ①X③ | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WAITS) | DEMAND (WATT-HO CYCLE) (DXC/) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | • |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |
| | | <u>.50</u> | • | | | • | |
| • | | MAXIMUM . | <i>.</i> | TOTAL | MAXIMUM | | TOTAL |
| •, | | • | | | • | | • |
| | • | • | | | | | |
| | | | • | | · | | |
| | | IHERMAL. | REQUI | REMENTS | | | |
| SOURCE | | LATENT (BTU/HR) | | SIBLE U/HR) | HEAT LEAK (BTU/HR) | | COOLANT STU/HR) |
| 7 . 7 | | • | • | Ŋ | -179 | | F 17 |
| Elessie | | () | | / ! | 177 | | |
| | | | | | | | |
| | | | | | • | | |
| | | | | | | | |
| 1 | TOTAL | 0 - | En | 470 | -2.3 (-0 |) !~• | - /- |
| | TOTAL | WATT (BTU/HR) | | (BTU/HR) | WATT (BTU/HR) | ∠ —— ∆ WATT | (BTU/HR) |
| • | | _ | | | • | | |
| • | | • | | . • | • | • | |
| ORIGINAL PAGE OF POOR QUALT | is Iy | , , | • | • | - | • | |
| • | Ō | PERATION | AL PE | MALTIES | | | |
| ,, | | THERMAL | | ELECTRICAL | WEIGHT | , , | OLUME |
| , SOURCE | HEAT (BTU/HR) | | COOLANT /HR/CYCLE) | (PK WATTS/CYC | | | /MISSION) |
| N/A | | | • | | | | |
| | | , | | - | | | |
| | | | | | | | |
| , | | | • | *********** | ··· | | |
| | | | | | · · · · · · · · · · · · · · · · · · · | | • |
| | | | | | | | |
| 10 | DTAL <u>natti</u> (BTU/i | S/CYCLF WA | TTS/CYCLE U/HR/LYCLE) | | KG/MISSI (LB/MISSI | ON HY, | MISSION) |

| | | 11 P T.O 11 T. | | A 11 | W = c | |
|--------------|----------------------------------|---|---------------------------|----------------------------------|---|---|
| COMPONENT | <u>FIXED</u> (REF | WE 1.6 H 1/Y | WEIGHT (LBS) | Q W I B F M E. | | VOLIME (FT?) |
| | | | | | | |
| | | | | | | |
| A CAB | ATOT | · | 136 (36 KG (LBS) | c) | 0.33 | (); 3 (FT3) |
| AM PAGE TYPE | \$ 0 L 1 D E X UNITS/CYCLE(REF) | PENDABLE O WT/UNIT (RE (PKG.WT/UNIT) (LB) | (E) WIT/CYC | R E Q U I R E LE VOL (PKG. | MENTS (4) /UNIT (REF) VOL/UNIT)(REF) (FT ³) | , 3 3 1 1 1 1 1 1 1 1 |
| i i | | | | | | |
| TOTAL WY. | | | 70TAL W17 | CYCLE | - Σ⑤ | 101A1 VOL/(|
| | iles, , x | DAYS/MISSION | X TOT.WITCYCL (LB) | • | | 6 (LB). |
| MISSION CYC | LES/DAY X | DAYS/MISSION | X | • | | יוֹזי) ד |
| TYPE | GAS/LIQUI | D EXPEN | DARLES R RECOVERY FACTOR | EQUIREM AMT.RECOVE () () | 3) RED/CYCLE | AMT LOST/CT ①-③ (LB) |
| | T | | | | | |
| TOTAL UT. | Σ ① | • | | | Σ@ | |

C2-27

| SPACECRALT | Space Static | <u>n</u> |
|------------|------------------|--|
| HABITABILI | ITY SUBSYSTEM FO | od Management HABITABILITY FUNCTION Food Storage |
| APPL1ANCE | TUNCTION Ref | igerated Storage |
| APPLIANCE | CONCEPT NO./TITE | E 2/Thermoelectric |
| THEFT HA | 1132 | REF. NO. 184, 177 |

DESCRIPTION: In this concept, the refrigerator has a self-contained cooling unit operating on the thermoelectric principle. Direct electrical current is passed through staged semi-conductor junctions arranged such that heat is removed at one set of junctions (providing the cooling) and rejected at the other. The refrigerator engineering data used were taken from Reference 184 and 177, which were obtained from catalogue data for commercial units. The reference weight and volume were given separately for the refrigerator locker and the thermoelectric devices. To keep the concepts on a common basis, the weight and volume of the locker were assumed equal to the locker for the space radiator concept #1.



1

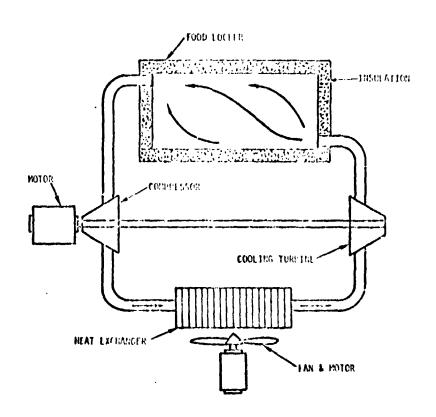
| CONCEPT 1/ | APPLIA: | ICE CONCEPT PEQUE | arrais bio | PENALTIES CAL | COLATIONS INDEX | NUMBER |
|---|----------------|-------------------|----------------|-----------------------|-----------------|-------------------|
| Charles of | | | | | | |
| | ELECI | | OMER | REQUIR | | |
| | 0 | | PONT | (4) | 0.0 | |
| | CYCLE CYCLE | PEAK . | (3) AVERAGE | DEMŽÍLO (WATT-HR/ | (5) PEAK | O DEIM |
| OMPONENT (REF) | (HR) | (WATTS) | (WATTS) | CYCLE) | (WATTS) | (WATTS) CYCLE |
| | | | • | C , C , | <u> 225</u> | |
| 1, | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | · | | | | |
| | | | | | | |
| | | • | • | | | • |
| | | | • | | 225 | |
| • | | MAXIMUM | · | TOTAL | MUMIXAM | . TATAL |
| INAL PAGE IS | _ | • | | | | , |
| OOR QUALITY | • | | | | | - |
| Q | | | | • | | |
| | | THERMAL | REQUI | REMENIS | 1 | |
| • | | LATENT | SENS | SIBLE | HEAT LEAK | TO COOLANT |
| Source | | (BTU/HR) | | J/HR) | (BTU/HR) | (BTU/HP) |
| | | • | | | 10.0 | |
| | | <u> </u> | - | 7.1 | <u> </u> | |
| <u>!- </u> | | <u>^^</u> | | 21_ | 148 | 443 |
| | • | | | | | |
| | | | | | | - |
| | | | · | | | |
| | | | | | (- | |
| | TOTAL | | 121 | (11:) | -8.8 (-30 | |
| | | WATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT (GTU/HP) |
| • | | • | | | | |
| | | | | | | |
| | • | | | • | | • |
| • • | | | • | | | |
| | g | PERATION | AL PE | MALTIE | <u>s</u> | |
| . • | , | THE PIAAL | | | | • . |
| | | LEAK TO | COOLANT | ELECTRICA | | |
| SOURCE | (BTU/IIR | CACLE) (BIO) | /HR/CYCLE) | (PK WATTS/C | YCLE) (LB/MISSI | ON) (FT*/MISSION) |
| N/A | | • | ·. | | | |
| | | • | | | \ | |
| | | | | . | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 1 | TOTAL | | • | | | |
| • | WATT | S/CYCLE WAT | TS/CYFLE | | KG/M1551 | ON MYMISSION |

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CRECH ATTOMS (CONCLUDED) INDEX NUMBER 1. WEIGHT/VOLUME FIXED REQUIREMENTS WEIGHT (LBS) VOLUME COMPONENT (REF) RIGINAL PAGE IN KG (LEC) M3 (FT3) SOLID EXPENDABLE M INTO F REQUIREMENTS VOL/UNIT (PEF)
(PKG.VOL/UNIT)(PEF)
(FT)) WT/UNIT (REF)
(PKG, WT/UNIT)(REF) 0 TYPE UNITS/CYCLE (REF) (LB) $\Sigma \overline{\odot}$ TOTAL WIVEVELE TOTAL WT. TOT.WITCYCLE DAYS/MISSION TOTAL VOL ... TYCLES/DAY DAYS/MISSION 701.VOL/CYCLE (FT3) REQUIREMENIS GAS/LIQUID EXPENDABLES AMT . RECOVER TO / CYCLE RECOVERY AMT.USED/CYCLE(REF)
· (LB) TYPE FACTOR $\Sigma \odot$ Σ 0 DAYS/HISSIUN X YOTAL LOSY/CYCLE KG (LD) EYCLL/DAY & O (LB)

D**118561-4

| SPACECRAFT Space Station |
|---|
| MABITABILITY SUBSYSTEM Food Management MABITABILITY FUNCTION Food Storage |
| APPLIANCE FUNCTION Refrigerated Storage |
| APPLIANCE CONCEPT NO./TITLE 3/Air-cycle turbine/compressor |
| INDEX NO. 1.1.2.3 REF. NO. 184 |

DESCRIPTION: In this concept, air is alternately compressed and expanded in a closed refrigeration cycle. This concept was included for comparison since it represents a typical commercial aircraft system. In an aircraft, ram air is used to cool the heated working fluid, whereas in the spacecraft system a motor and fan are used.



| ` ' | 1 1 1 1 | | , , , , , , , , , , , , , , , , , , , | | | | | |
|-------------------------|---------|------------------|---------------------------------------|--------------------|-----------------------------|--|----------|--------|
| | | ELECT | • | | R E QUI K E | H F H <u>T S</u> | | |
| | | USE Able | | PONE | (4) DEPAYO (WALT- HRZ | | <u> </u> | ٩ |
| | | | ② | (3) | DETÍARO OMALTARAZ | (5) | (6) | (W/ |
| COMPONENT | (REF) | CYCLF (HR) | PEAK (WATTS) | AVEPAGE (WATTS) | CYCLE) (DXCE) | PEAK (WATTS) | AVEPAGE | `°' |
| | | | | (MALIS) | (1) x (3) | (MVL12) | (WATTS) | (|
| | 1 | | .11,00.2 | | | • | | |
| | | | | | | ************************************** | | , |
| | | | | | | | | · |
| | | | | | | | | |
| | | | | | | - | | |
| • | | | | - | | | | |
| | | | • | - | | ******* | • | • |
| | | | 11,029 | • | | | | |
| | | | MUNTERM | | TOTAL | MUMIXAM | • | , - |
| | | | | | | | | , |
| enal Page Poor Quali | 18 | • | • | | | | | |
| INAL PAGE | TY | | | • | | | | |
| BOOK down | | | | | | | | |
| | | | IHERMAL' | Krdnik | EPENYS | | | |
| • | | | LATENT | SENS | IBLE | HEAT LEAK | 70 | COOLA |
| | | | | | | HEN! LENN | 10 | |
| SOURCE | | | (BTU/HR) | (810 | | (BTU/HR) | | |
| SOURCE | | | | (BTU | /HR) | | | |
| SOURCE | , | | | | /HR) | (BTU/HR) | | |
| SOURCE | | | | (BTU | /HR) | | | |
| SOURCE | <u></u> | | | (BTU | /HR) | (BTU/HR) | | |
| SOURCE | | | | (BTU | /HR) | (BTU/HR) | | |
| SOURCE | | | | (BTU | /HR) | (BTU/HR) | | NTU/HF |
| SOURCE | | | | (BTU | /HR) | (BTU/HR) | | 10/Hi |
| SOURCE | | TOTAL | (BTU/HR) | (870 | /HE) | (BTU/HR) | | 10/Hi |
| SOURCE | | TOTAL | | (870 | /HE) | (BTU/HR) | | 10/H |
| SOURCE | | TOTAL | (BTU/HR) | (870 | /HE) | (BTU/HR) | | 10/H |
| SOURCE | | TOTAL | (BTU/HR) | (870 | /HE) | (BTU/HR) | | 10/H |
| SOURCE | | TOTAL | (BTU/HR) | (870 | /HE) | (BTU/HR) | | 10/H |
| SOURCE | | TOTAL | (BTU/HR) | (870 | /HE) | (BTU/HR) | | 10/HF |
| SOURCE | | | (BTU/HR) NATT (BTU/HR) | WATY (| /HE) | (BTU/HR) | | STU/HF |
| SOURCE | | | WATT (BTU/HR) | WAIT (| /HE) | (BTU/HR) | (B | STU/HF |
| , | | <u>0</u> Neat | MATT (BTU/HR) PERATION THERMAL | MAIT (| MALTLE S | (BTU/HR) // MATT (BTU/HR) | (E | (BTU |
| SOURCE | | <u>0</u> | MATT (BTU/HR) PERATION THERMAL | WAIT (| MALILES | (BTU/HR) // MATT (BTU/HR) | (E | (BTU |
| SOURCE | E | <u>0</u> Neat | MATT (BTU/HR) PERATION THERMAL | MAIT (| MALTLE S | (BTU/HR) // MATT (BTU/HR) | (E | (BTU |
| SOURCE | | <u>0</u> Neat | MATT (BTU/HR) PERATION THERMAL | MAIT (| MALTLE S | (BTU/HR) // MATT (BTU/HR) | (E | (BTU |
| SOURCE | E | <u>0</u> Neat | MATT (BTU/HR) PERATION THERMAL | MAIT (| MALTLE S | (BTU/HR) // MATT (BTU/HR) | (E | (BTU |
| SOURCE | E | <u>0</u> Neat | MATT (BTU/HR) PERATION THERMAL | MAIT (| MALTLE S | (BTU/HR) // MATT (BTU/HR) | (E | STU/HF |

AC/MISSION (LP/MISSION)

(11.7M12210.2) M,\\\ M12210.8

NATIS/CYCLE WATTS/CYCLE (BTU/HP/CYCLE) (LTU/HP/LYCLE)

TOTAL

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS. (CONCEULTD) INDEX NUMBER 🛴 WEIGHT/WOLUME REQUIREMENTS WE IGHT VOLUME (FT") COMPONENT (REF) ORIGINAL PAGE IS TOTAL OF POOR QUALITY KG (LBS) M3 (FT3) EXPERDABLE MINOL REQUIREMENTS <u> 5 0 L 1 D</u> MT/UNIT (REF)
(PKG_WT/UNIT)(REF)
(L8) VOL /UNIT (PEF)
(+KG. VOL /UNIT) (PEF)
(FT3) 0 TYPE UNITS/CYCLE (REF) $\Sigma \overline{\mathfrak{G}}$ TOTAL WITCHCLE (LB) TOTAL WT. DAYS/MISSIM I TOT WITCHE (LB) CYCLES/DAY TOTAL VOL MISSION DAYS/HISSION X CYCLES/DAY TOT. VOLTCYCLE 6 A S/L I Q U I D EXPENDABLES REQUIPEMENTS 0 AMT.RECOVERFO/CYCLE

(LB) RECOVERY MIT. USEU/CYCLE (KET) TYPE FACTOR · (LB) $\Sigma 0$ TOAYS/HISSION TO YOLALT OST/CYCLE ks Till

(LB)

4 0

· D24135014

| HABITABILITY SUBSYSTEM 1.0 |) Food Management |
|--|---|
| HABITABILITY FUNCTION 1.1 | Storage |
| APPLIANCE FUNCTION 1.1 | .3 Frozen Storage |
| NUMBER OF CONCEPTS CONSIDERE | D |
| ASSUMPTIONS: The Space Stat follows (see food management | ion freezer capacity assumed in this study was as description): |
| Number of units: | 13 . |
| Individual unit packaged findividual unit packaged food weight | food volume 0.0592 cu m (2.09 cu. ft) 311 kg (685 lbs) |

Freezer box insulation thickness was assumed to be $10.16\ \mathrm{cm}$ (4.0 inch) for all concepts.

| CONCEPT USAGE | | CONSUMBBLES_A | AND FLCW | REGULACIENTS | SANI | THERMAL REGHTS | | ELEC PUR | REGNTS_ | _MT/VOL_REGMTS | | COST | Δ. |
|-------------------|---|---------------|----------|--|------------|--------------------|--------------------|--|---|--|----------------------------------|--|-------------|
| 75058H W85/08E | DAY_TYPE SE (+) | TPE USED | 100 | PRESS THE PRESS TO | i LUL | COOLANT FRATTS: | HT LEAK HRATTS: | A AC BC BC BC BC BC BC BC BC BC BC BC BC BC | V C C C C C C C C C C C C C C C C C C C | 1 | VOLUME: A | AVAIL INDE | # H I G I I |
| |) (DO) 1(DOO)) DOO | 110000 | 900 | 80 | 23.3 | 715. | 42271.1 | 0.05 | 00 | 589.7 | 2.70 | 0 | 0.0 |
| 2 .000 | 00 | | | | | 7869. | 1915. | 11240.0 | 00 | 1476.9 | 5.04 | 2 25 | 0.0 |
| 0. | .000 | | | | | 8679. | 42920 | 14700.0 | 00 | 924.2 | \$128 (185,50) | 2 70 | 00 |
| | | | | | | | | (*) 1 - CABIN AIR 2 - CABIN AIR | i | CIRCULATED) | | | |
| NO. | 3 3 N O 2 | 4 2 - 4 | 3 8 1 | | | | | | WATER | (CIRCULATED); | | (18/nd) | • |
| 2 | SPACE RADIATOR THERMOELECTRIC AIR CTCLE | 10 m | | | | | | 5 - WATER 7 - NITROSEN 7 - NITROGEN 8 - FREGN | | (CIRCULATED), (CIRCULATED), (USED), (CIRCULATED), | 76/77 76/77 76/78 76/78 | 76 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | |
| | | | | ()z. | ORII OR | | | • | 2 | | | ST | |
| | | | | | 200 | | | (1) AVAILABLE | ב | | 3 | 0-25% | |
| | | | | | J. | | | (2) STATE OF (3) SOME DEV | STATE OF THE ART SOME DEVELOPMENT | STATE OF THE ART SOME DEVELOPMENT REQUIRED | K G | 25-50% 50-75% | I |
| | | | | | AUAI | | | | EXTENSIVE DEV. NEQUIRED | EQUIRED | 75. | 75-100% | |
| | | | | | TY | B | | | | | | | |

27.014

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - SPACE RADIATOR
2 - THERMOELECTRIC
3 - AIR CYCLE

CONCEPT NUMBER

Frozen Food Storage (Space Station) Concept Trade

4]

| LBS/WATT) TYPE 1 .7100 LBS/WATT) TYPE 2 .5910 LBS/WATT) TYPE 2 .5910 NAM | USES MOD SUBROUTHERMAL PENALTY | SUBROUTINE OF | TO COOL | OLANT (| L8/810 | H) .0540 | 0 | | |
|--|--------------------------------|---------------|---------|---------|--------|----------|-------|--------|------|
| MIN WALUE PTS 1 2 3 C. D. N. C. E. P. T. S. S. S. S. S. S. S. S. S. S. S. S. S. | POSER PENALTY POSER PENALTY | (LBS/WATT) | TYPE 1 | 17. | | 1 | O to | | |
| #IN MAX | | | | | | | | | |
| 1300.0 185.0 15 14.06 10.0 6.61 1300.0 1355.0 15 14.06 6.60 10.0 6.61 16.50 16.5 | 31126 | TION MATE | | 19735 | • | اجا | 1 1 | (SPACE | |
| 1300.0 3256.0 15 9.01 .00 6 35.500 11857.0 15 14.96 6.60 95.500 185.50 10 4.65 .37 86.51 .94050 5 2.77 .19 86.51 .94050 5 2.65 .37 80.00000 1.0000 5 5.00 .00 5 80.00000 85.000 85.000 85. | | | | | | | 1 | 1 1 | |
| 1309.0 1356.0 13657. 15 14.96 6.60 95.500 1365.50 1365.60 137. 15 15.69 15 6.60 96.81 99.99 9 5 2.65 90.000 90.000 10.0000 10. | 1 | | | | - 1 | ~ | | | |
| 95.500 185.50 10 4.65 .37 .85 .86 .93 .94 .95 .95 .95 .95 .95 .95 .95 .95 .95 .95 | . 1 | | 56.0 | 1 | - 1 | 09.9 | 6.63 | | |
| .00000 100.00 100 82.27 26.6 13 | VOLUME 95.5 | | 5.50 | | | .37 | 00. | | |
| 7 .00000 1.0000 5 5.00 .00 5 .000 5 .000 5 .000 5 .000 5 .000 5 .000 5 .000 5 .000 5 .000 5 .000 5 .0000 5 .0000 6 .00 | RELIABAY .865 | | 1050 | 1 | ı | 61. | 80. | | |
| T .00000 | Ü | | 9999 | 1 | - 1 | - 26- | 5.00 | | D |
| 6 .00000 100.00 100 82.27 26.66 13 | | | 000 | i | | 9.64 | 11.63 | | |
| | | | | | .27 | 9 | 13.68 | | 5.,6 |
| | | | | | | | | | • |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | • | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

1

| NUMBER OF | DAYS | 2.00 | YEARSI | | | | | | | | : | |
|--------------------|-------------------------|---|--------------|-----------|--------|--------|-------------------|---|-----------|--|--------------------|----------|
| THERMAL P | SUBRO ENALT ENALT | | COOLANT | (LB/BTUH) | 1 1 | .0540 | | | | | | |
| | | 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | -2 | 2165 | | | | | | | | ! |
| | SELECTION | TATE X | 2741710 | 51 | FROZEN | F000 S | STORAGE (SPACE ST | STATIONI | | | | |
| | 2 | MAN | | | | | - a | | | | | 1 |
| FACTOR | VALUE | VALUE | PTS | - | 7 | • | 1 | | | | | |
| WEIGHT | 1300.0 | 3256.0 | 51 | 4.01 | 00. | 6.63 | | | | | | . (|
| VOLUME | 005+54 | 185.50 | 01 | 4 6 55 | .37 | 00 | | | | | | |
| THERMAL BE. | 4 | 347607 | i | - 15.69 | -11.5 | 65. | | |)RI | | | |
| MAINTENC | - 1 | 66666 | · & | 2.65 | •76 | 88 | | | G P | | ; | 1 |
| SAFETY Dev coet | | 1.0000 | ر د د | 5.60 | 00. | 8.00 | | | NA OOI | | D. | |
| TOTAL PT | t | 85.000 | . 69 . 29 | | 22.57 | 11.63 | | | L Q | And the second s | - - - | |
| RATING | 00000 | 100.00 | 801 | 81.33 | 26.55 | 13.68 | | | AGE 1 | | 304. | |
| | | | | | | | | | 8 | | 7 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | , | | | ; ; ; ; | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | ! |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| 1 2 3 CONCEPT 1 2 3 CONCEPT 1 2 3 CONCEPT 1 2 3 CONCEPT 2 3 2 3 3 3 3 3 3 3 | 81.33 26.55 13.68 79.61 24.40 16.16 82.82 27.96 12.57 79.51 25.28 12.57 80.14 25.84 13.29 80.53 26.22 13.29 81.87 25.79 16.15 82.85 279 16.15 | | |
|--|--|---------------------------------|--------------------------------|
| ## ## ## ## ## ## ## ## ## ## ## ## ## | 81.33 26.55 13.68 79.61 24.40 16.16 82.82 27.96 12.57 79.51 25.28 12.92 83.22 27.16 12.57 80.14 25.84 13.29 80.53 26.22 13.29 81.87 25.79 16.15 82.85 25.79 16.15 | | |
| 1,13 24.55 13.48 | 81.33 26.55 79.61 24.40 82.82 27.96 79.51 25.28 83.22 27.16 80.53 26.22 81.87 25.79 82.85 29.61 | | |
| SINGLE SENSITIVITY ANALYSIS SINGLE SELECTION PROMERT AFTER INCREASING SINGLE SELECTION PROMERT AFTER INCREASI | 79.61 24.40 79.51 25.26 79.51 25.26 63.22 27.16 80.14 25.84 80.53 26.22 81.87 25.79 | | |
| SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE SELECTION PARHETER RELOWING FACTOR BY SO S 1 | 03.22 27.16 03.22 27.16 03.22 27.16 03.53 26.22 01.87 25.79 02.05 25.79 | 08 | |
| SENSITIVITY_ANALYSIS SINGLE SELECTION PLANALYSIS SINGLE SELECTION PLANALYSIS SINGLE SELECTION PLANAKTER RECARTING FACTOR BY SO S SINGL | 80.14 25.84 80.53 25.22 81.87 25.79 | 03 | |
| SENSITIVITY_ANALYSIS SENSITIVITY_ANALYSIS SINGLE SELECTION PARMETER RELATING FACTOR BY_SO S SINGLE SELECTION PARMETER RELATING FACTOR BY_SO S 1 | 01.67 25.79 01.67 25.79 02.65 29.61 | OB O | Appeller de statemente de mine |
| SENSITIVITY ANALYSIS SENSITIVITY ANALYSIS SINGLE SELECTION PRANKTER WIGHTING FACTOR BY -50 s (BASED DN 100 S MAX POINTS) 1 2 3 C O M C E F T 81.33 26.55 13.66 93.39 27.12 10.73 79.55 27.90 11.07 79.53 22.90 15.01 79.53 22.90 15.01 | ZV-CGSI6Z.65ZV.611 | | |
| SENSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFFER INCREASING SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY \$-50 S 1 2 3 C O. N. C. E. F. T 1 2 3 C O. N. C. E. F. T 1 2 3 C O. N. C. E. F. T 1 3 24.55 13.46 1 3 24.55 13.46 1 4 20 12.01 1 5 0.12 10.73 1 6 0.13 24.55 13.46 1 7 10.73 11.07 1 7 10.73 11.07 1 7 10.73 11.07 1 7 10.73 11.07 | 1 | | |
| SINGLE SELECTION PARAMETER AFTER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY SO S (BASED ON 100 S MAX POINTS) 1 2 3 C.O.N.C.E.T.T 81.33 22.55 13.68 83.37 22.96 15.01 82.60 27.30 14.10 82.60 27.35 11.07 79.55 22.90 14.10 82.77 27.35 11.07 79.55 22.90 15.01 | | BOC EXT | |
| SINGLE SELECTION PARAMETER ACTION PARAMETER ACTION PARAMETER ACTION BY SSO S (GASED ON 100 S MAX POINTS) (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CASE 13.60 (CON CE CT (CON | | L'A | |
| SINGLE SELECTION PARABETER HUGREASING (BASED ON 100 S HAX POINTS) 1 2 3 C O N C E F T (B1.33 26.55 13.68 83.39 29.12 10.73 77.09 25.82 14.54 77.09 25.82 14.10 82.60 27.30 14.10 82.60 27.30 14.10 82.60 27.30 14.10 82.70 11.07 79.53 22.90 15.01 | | AGUA | |
| 1 | RATING FOR EACH CONCEPT AFTER INCR | 1.6 1.6 1.0 1.0 1.0 | |
| 81.33 26.55 13.68 83.39 29.12 10.73 79.56 24.86 15.01 83.39 27.98 14.54 79.09 25.82 15.01 82.60 27.30 14.10 82.17 26.90 14.10 80.77 27.35 11.07 79.53 22.90 15.01 | (BASED ON 100 S MAX POINTS) | | 1 |
| 81.33 26.55 13.68 83.39 29.12 10.73 79.56 24.86 15.01 83.39 27.98 14.54 79.09 25.82 15.01 82.60 27.30 14.10 82.17 26.90 14.10 80.77 27.35 11.07 | CONCE | | |
| 83.39 29.12 79.56 24.86 83.39 27.98 79.09 25.82 82.60 27.30 82.17 26.90 60.77 27.35 | ° 2 | | |
| 83.39 29.12 79.56 24.86 83.39 27.98 79.09 25.82 82.17 25.90 80.77 27.35 79.53 22.90 | 11 01.33 26.55 13.6 | | |
| 83.39 27.98 79.09 25.82 82.60 27.30 82.17 26.90 80.77 27.35 79.53 22.90 | 83.39 29.12 | | |
| 82.60 27.30 82.17 26.90 80.77 27.35 79.53 22.90 | 63.39 27.98 | | |
| 60.77 27.35 60.77 27.35 79.53 22.90 | 82.60 27.30 | | |
| | 80.77 27.35 79.53 22.90 | | |
| | | | |

APPLIANCE CONCEPT COMPONENT SURMARY MATRIX

APPLIANCE FUNCTION: 1.1.3-FREEZERS

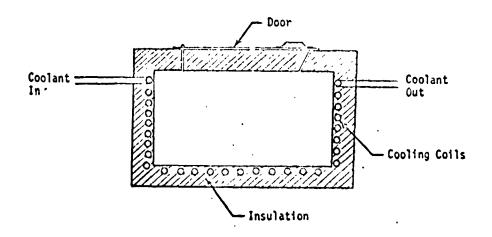
| ı | | |
|-------|---------------------------------|--|
| | NUMBER CF SAFETY CAITICAL ITE'S | O + O . |
| | 0 | |
| | 0 | |
| | 0 | |
| | 0 | |
| T S | 0 | • |
| NEN | 0 | |
| Р 0 | 0 | |
| C 0 M | 0 | |
| u. | 0 | |
| 0 | 0 | |
| E R | © ВГОМЕ В | 1 0 F |
| M M | © СОИТ ROLLER | |
| 2 | EXCHANGER HEAT | ○ 1 H |
| | AVENE O SOLENOID | N I I |
| | dW∩d ⊘ | н 1 0 |
| | яоток 🕀 | 2 2 2 |
| | 74PE | |
| | COMPOWENT TYPE APPLIANCE TYPE | SPACE RADIATOR THERMOELECTRIC AIR CYCLE TURBINE/COMPRESSOR |
| | APPL | SPAC THE: AIR |

| SPACE CRALT | Space Station | |
|-------------|--------------------|---|
| навттивн | TIY SUBSYSTEM Food | Management MADITABILITY FUNCTION Food Storage |
| APPLIAGE | FUNCTION Froze | n Food Storage |
| APPLIATIOE | CONCLPT NO./FILE | 1/Space Radiator |
| INDEX NO. | 1.1.3.1 | REF. NO. 184, 255 |

DESCRIPTION: This concept is simply an insulated food storage box, with coolant from the spacecraft ECS radiators routed through tubing within the free or walls. This concept was used for the five Skylab food freezers, each of which had the following size:

| | WE: | IGHT | VOLU | ME |
|---|------|------|--------|-------|
| | kg | 1b | cu ni | cu ft |
| Food capacity (packaged and restrained) | 24.1 | 53.2 | 0.0598 | 2.11 |
| Total Freezer (empty) | 45.8 | 101 | 0.210 | 7.41 |

The Space Station freezers were sized proportional to the above Skylab data based on the freezer food capacity. The wall insulation was 10.16 cm (4.0 inch) thick. It was assumed that the radiator coolant would be of sufficiently low temperature for the concept to be feasible.



| / | | | | | INDEX 6 | |
|---|-----------------------|-------------------|---------------------------|---|-------------------------------|---|
| Contract | ELECT | <u>EICAL</u> P | OWER | REQUIRE | MENTS | |
| | | POWEF | | | | |
| MPGNENT (REF) | CACFE (HB) | A C PLAK (WATTS) | (3) AVLP/+E (WATTS) | DEMAND (WATT-HE) CYCLE) | (5) PE/) | (6) DELLA |
| | • | (1) | (mary) | ()/·(| (#////3) | (1) (1) |
| | | | | | | |
| والمراجعة والمحاجمة والمحاجمة والمحاجمة والمجاجمة والمجاجمة والمحاجمة والمحاجمة والمحاجمة والمجاجمة والمجاجمة | **** | | | | Printer and the second of the | |
| | ************ | <u> </u> | | | | |
| | **** | | | | | makening of discountry or a register |
| | | | | | | |
| | | | | | | |
| | | | | | | · |
| | | MAXIMUM | | 101/L | MAXIMUM | |
| • | | | | | | |
| | • | • | | | | , |
| | | | • | | | |
| SOURCE | | (BTU/RR) | (BT: |)/HE) | (BIO/HE) | (BTU/HP) |
| | | <u> </u> | | | - 19/1/ | |
| <u>/. :</u> | | • | 1 | 11 | 1.1. | |
| | | | | | | |
| | | | | | | a a supplied of the |
| | * , p ======== | | | ~ ~~~~ | ******** | |
| | **** | , . | rn | 1, 1 | -(' (| $\mathcal{L}_{\mathcal{L}}$ |
| | TOTAL | WATT (BTU/HR) | | | WATT (BIU/HR) | |
| | | • | WALL (| e a a a a a a a a a a a a a a a a a a a | warr (brother) | WATT (ETH/HE |
| • | | | | | | |
| | | | | | | • |
| | | • | • | | | |
| | | | | | | , |
| | ò | <u>PERATION</u> | AL PE | NALIJES | | |
| | • | PERATION THERMAL | | | | • MOLANIF |
| \$0 URCE | HEAT | THERMAL TO | 000LA*+T | ELECTRICAL | WEIGHT | • VOLUME ON) (F [†] /MISSION |
| \$O URCE | • | THERMAL TO | | | WEIGHT | |
| \$0 URCE \(\lambda\!/\) | HEAT | THERMAL TO | 000LA*+T | ELECTRICAL | WEIGHT | |
| | HEAT | THERMAL TO | 000LA*+T | ELECTRICAL | WEIGHT | |
| | HEAT | THERMAL TO | 000LA*+T | ELECTRICAL | WEIGHT | |

LG/MISSION (LB/MISSION) RYMISSION (FTYBLESION)

WATES/CYCLE WATES/CYCLE (BID/HR/CYCLE)

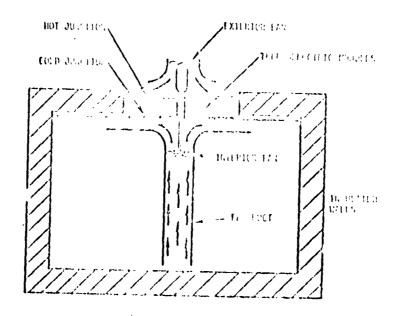
TOTAL

| CO | MPONENT | £1) | (REF) | <u>E 1 0 H 1/1</u> | MEI NET TWE | REQ (GHT (P1) | UIPEMEŅ | | VOLUME (FT) |
|-----------------|------------------------|---------------|---------------------|---|----------------|---------------------|--|------------------------|-------------------------------------|
| | 1 | <u>(, `)</u> | | *************************************** | | | ······································ | (| |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | PAGE IS QUALITY | | TOTAL | . '[| F 27 | | | | |
| oon 4 | CONTILL | | | | KG (| | | • | 3 (FT3) ´, |
| | | <u> </u> | | NDABL O WT/UNIT (I | rif) | 3 NT/CYCLE | E Q U I R E | (PEF) | AOT VCALTE |
| • | TYPE At 1 A | UNITS/CYC | | PKG.WT/UNI (LB) | I)(UF) | (LB) | (PKG.V | OL/UNIT)(PEF) (FI') | (+13) (1) (4) |
| | | | | | | | | | |
| | | | - | | | | | | |
| | | | | | | | | | |
| | | | •• | * | Σ③, | UTAL WT/Ci | c. (| Σ⑤ | TOTAL VOLVČYC (FT ³) |
| <u>101</u> M | TAL WT. | CYCLES/DAY | Xhave | anici izac | x | • | | | |
| <u>10</u> 1 | TAL VOL - MISSION - | CICLESTUAT | UATS | /หัวรับโอก์ | 101 | (LB) | _ | , | G (Lb) |
| • | MISSION | CYCLES/DAY | XDAYS | /mission — | - X TOT | .voT/crciE (FT?) | | <u> </u> | 7 (111) · · · |
| | | 6 A S/I | <u>1 Q U 1 D</u> | FYDF | NDARLE | · | QUIREM | FNTS | ٠ |
| | ` | | Φ | | Q | | AMT. RECOVER |) FD/CYCLE | AMT LOST/CYC |
| | TYPI | E, | MT.USED/LYC (LB) | LE(REF) | - RECOV | | (LB | | (; B) |
| · | | | | , | | | | | |
| _ | | | | | | | | | |
| | | | | | | | | Σ@ | |

D2-H8564-7

| SPACECRAIT_Space_Station | |
|-------------------------------------|--|
| HABITABILITY SUBSYSTEE Food Manager | ent_MABITALILITY [UMC110% Food Storage |
| APPLIANCE FUNCTION Frozen Food St | orage |
| APPLIANCE CONCEPT NO./TITLE 2/The | rmoelectric |
| 1RDLX RO. 1.1.3.2 | REF. NO. 184, 177 |

DESCRIPTION: In this concept, the freezer has a self-contained cooling unit operating on the thermoelectric principle. Direct electrical current is passed through staged semi-conductor junctions arranged such that heat is removed at one set of junctions (providing the cooling) and rejected at the other. The freezer engineering data used were taken from Reference 184 and 177, which were obtained from catalogue data for commercial units. The reference weight and volume were given separately for the freezer locker and the thermoelectric devices. To keep the concepts on a common basis, the weight and volume of the locker were assumed equal to the locker for the space radiator concept #1.



| CONCEPT | APPLIAN | CL CONCLET FT. | dremakis <i>ta</i> b | re ALTIES CALC | .HEATTON | RUMPER |
|---|---------------------------|--------------------|----------------------------|--|---|--|
| · · · · · · · · · · · · · · · · · · · | | | | | | |
| | ELECT | PICAL | | k i d n i b i | | |
| | (1) | | C. POKL | k - 70 - | D.C. | POWED O |
| COMPONENT (REF) | CACLE Take The | (WATTS) | (WATTS) | # - (4) - DETT OF (WATT NO!) - CYCLE! - (D) x (2) | (5) (WATTS) | (6) DEFINIO (KATE 107) AVERAGE (CYCLE) (WATTS) (1) X (7) |
| | | | | | 11, 12 | |
| | | | | | | |
| | | | | | | |
| desire with the desirement of the first state of | ******* | | | | | |
| | | | | | Processor of the control of the control | |
| | | | | | | dissipation received the second of the secon |
| | | • | · * | | traum meteravar delitera a | • |
| , | | PIAXINUII . | • | JATOF | MUMIXAN | |
| | | | | | | • |
| | : | I H E R M A L | REQUI | PEMENTS | | |
| SOURCE | | LATENT (BTU/HR) | | DYHE) | (BTU/HF) | (PLIN/HE, |
| 1 | | | ا د دکست | | , , 1 | |
| 51 | | | | Sum | £1.50. | و د و و و د مو |
| , | , | | | ~ | - | |
| | | | | | | |
| | | | | | | |
| mention for the state at the formula and above the state of the state | | , | | · • • • | 101/ 1/11 | · · · · · · · · · · · · · · · · · · · |
| | TOTAL _ | WATT (BTU/HP) | | ETU/HP) | /2/2 /675 WATT (BRU/HR) | KATT (BTU/HE) |
| • | | | | | | ••• |
| | <u>o</u> | PERATIO. | NAL PE | NALTIES | <u>.</u> | |
| | | THERMAL T | O COULANT | ELECTRICAL | | VOLUME |
| SOURCE | (BTU/HR/ | CACLE) (E) | U/HR/CYCLE) | (PK WATTS/CY | CLE) (LB/MISSIO | N) (FT'/MISSIU') |
| 1/1/4 | | | | | | Mar 6.4 |
| | | | | | | Maked with a regulation is sometime are in |
| | | | | | | **** |
| | | | | | | |
| <u></u> | | , | | | | * |
| | | | | are we therefore, | | |
| • | TOTAL NATIS (610/11 | VOGET TE | ATTS/CYCLE TU/HM/CYCLE) | | KG/H15510 (LB/H15510 | N) (FT VMISSION) |

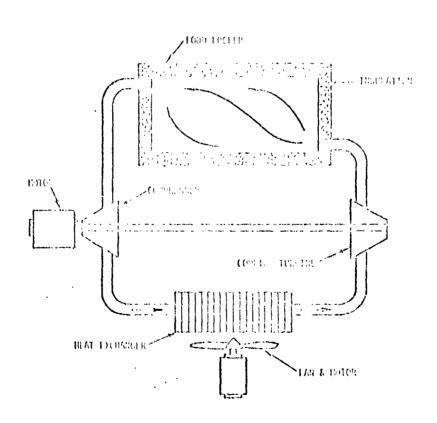
C2-46

APPLIANCE CONTENT SECRETERY OF ME SENSETIES COLORAGENS (CONTENTS)

INDEX NUMBER () WEIGHT/VOLUME REQUIREMENTS 1. WEIGHT (EDS) VOLUME (ři*) ORIGINAL PAGE IN OF POOR QUALITY TOTAL EXPENDABLE WIVOL REQUIREMENTS ∑③ TOTAL NI, CYCE. CYCLES/DAY DAYS/MISSION X TOT WIT/UNCLE (LB) ku (16) TOTAL VOL GAS/LIQUID REQUIPEMENTS EXPENDABLES RECOVERY AMT. USED/CYCLE (MEF.) Σ Thansymesses of Total Tostychile (LB) (z (i)

| SPACECRAE | Space Station | | pri | | | |
|------------|-------------------|-------------|-----------|-------|-------------|--|
| навітлен | ITY SUBSYSTEM Foo | Management | TRACLIA | вит | Y FUNCTION_ | Lood Storage |
| APPLIANCE. | FUNCTION Froze | Food Storag | <u>10</u> | | | agen y dig aliang pagamanana and and aliang aliang aliang aliang aliang aliang aliang aliang aliang aliang alia |
| APPLIANCE | CONCEPT NO./TITLE | 3/Air-cy | cle tur | bine/ | compressor | and the state of t |
| THINEY NO | 1.1.3.3 | | BLE I | 10 | 184 | |

DESCRIPTION: In this concept, air is alternately compressed and expanded in a closed refrigeration cycle. This concept was included for comparison since it represents a typical commercial aircraft system. In an aircraft, ram air is used to cool the heated working fluid, whereas in the spacecraft system a motor and fan are used.



D2 1185(17

| CORCEPT 1 | 1 | APPLIA: | NCE CONCERT REQU | IPEMERES AND | PENALTIES (ALC | INDEX V | iomera, <u>f. f.</u> | |
|---------------------------------------|---------------|---------------------------|---|---------------------------------------|---|--|---------------------------|---------------------------------------|
| () : | " 11 | . / . / / . | 5 1 (| | 0 (0) () () | тигытс | | |
| | | | | CYPEN Corpowe | REQUIRE | | POWLE | ₹ |
| COMPCNENT | (REF) | USE_TIME CYCLE (HR) | PEAK | (3) AVERAGE (WATTS) | (4) DENTAD (MATT-HE) (1) X (3) | (5) PEAK (WAITS) | (6) AVERAGE (WATTS) | (I) X (7) DEMAND (WATT HE) (I) X (7) |
| · · · · · · · · · · · · · · · · · · · | 1: | *** | . 16,700 | | | • | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | graph construction on the construction of the | | | | | |
| | | | - | | | | | |
| | | | ` | | | | • | * |
| | | | | | TOTAL | MAXIMUM | | . TOTAL |
| • | | | 191031100 | | TOTAL | 1111111111111 | | , 101112 |
| | | • | • | | | | • | |
| | | | THERMAL. | REQUI | REMENTS | | | |
| SOURCE | | | LATENT (BTU/HR) | | SIBLE U/HR) | HEAT LEAK (BTU/HR) | | OOL ANT |
| $r \cdot I = I$ | . / | | <u>n.</u> | ' | | -5111 | | |
| $E(I_i) = \{i, j, j\}$ | | | <u>, ,</u> | 45 | 712 | 12,160 | | 1,638 |
| ****** | · | | | | | Adjusting the second section is a state of | | ****** |
| - | | | *********** | | | | | ****** |
| | | | | | | | | |
| | | TOTAL | 11477 (1)711 (1)7 | | (1/21) | 422/19.15 | | |
| | | | WAT1 (BTU/HR) | WALL | (BTU/HR) | WATT (BTU/HR) | , 111 | (Bluyen) |
| | , | | | | , | | | |
| | | • | , | | • | | • | |
| | | ğ | <u> PERATIO</u> N | <u>ial pe</u> | NALTIES | · . | | |
| | , . | , MCAY | THERMAL | | ELECTRICAL | WEIGHT | • | LUME |
| SOURCE | | (BTU/HR | 'LEAK TO /CYCLE) (PTU |) COOLANT J/HR/CYCLE) | (PK WATTS/CY | | | MISSION) |
| <u> </u> | - | | | | | • | | |
| | | | , | | | | | |
| · | | | | | | | | • |
| ***** | | | | · · · · · · · · · · · · · · · · · · · | | | | |
| | | | | | | | | |

C2-49

WATTS/CYCLE (BTU/HR/CYCLE) AG/MISSION (IB/MISSICY) PTYMISSICR (FT YMISSION)

TOTAL

MATTS/CYCLE (BTU/F /CYCLE)

| COMPONENT | ·(REF) | | WEIGHT (LES) | | VOLUPTE (F1°) |
|---------------------------|----------------------------|--|----------------------|--|-------------------------|
| | | | | | |
| IGINAL PAGE POOR QUALI | IS TOTAL | . `[| RG (LBS) | 77. | 5.10 (/5.0) M3 (FT3) |
| TYPE / | SOLID EX UNITS/CYCLE(REF) | PENDABLE WI/UNIT (REF (PKG.WI/UNIT)((LR) | M 1/N Ö F M 1/N Ö F | F VOLZUMA | 4) (5) |
| | | Σ | TOTAL WIV | and the second s | Σ ③ ΤΟΤΑΙ Ψυλ/ CYC |
| TOTAL VOL | v | AYS/HIS. ION ——————————————————————————————————— | XTOT.VelVeY | * [| KG (LB) |
| ТҮРЕ | <u>G A S/L 1 Q U I</u> | | (FT ³) | EQUIREMEN AMT. RECOVER DATE (LB) | I <u>S</u> |
| | | | | - | |

112 12 14 1

| HABITABILITY SUBSYSTEM 1.0 Food Management | ~ |
|--|---|
| HABITABILITY FUNCTION 1.2 Preparation | |
| APPLIANCE FUNCTION 1.2.2 Warming | |
| NUMBER OF CONCEPTS CONSIDERED 3 | |

ASSUMPTIONS

Since current planning in the spacecraft food system area does not include a requirement for cooking, the concepts considered in this section apply to food warming only and not cooking. In Reference 184, it is recommended, for planning purposes, to size ovens based on 80 percent of the maximum allotted frozen food per man-day. Based on the Skylab food mix which was assumed in this study (which contained approximately 45.5 kg [100 lbs] of frozen food for 420 planned man-days), this would result in a warming unit sized for 0.109 kg (0.24 lbs) per man. This value is obviously low, due to the relatively short supply of frozen food in Skylab. Therefore, the design value of 0.385 kg (0.8472 lbs) and 0.00480 cu m (0.1696 cu ft) of food per man (References 184, 276) was assumed throughout this study to size the ovens. For Space Station, the oven food capacity was therefore 2.31 kg (5.1 lbs) and .0289 cu m (1.02 cu ft). Three meal warmings per 24 hours were assumed per man.

The detailed engineering data for Space Station food warming concepts were derived directly from the data used for the Shuttle concepts in Appendix B. The Shuttle warming concepts were based on a four-man crew; whereas, Space Station was based on six men. Therefore, all the Space Station weight/volume/power/thermal data were assumed to be 6/4 times the corresponding Shuttle data. This method of adjusting linearly for crew size was used in Reference 276 and was felt to be adequate for this effort. To compare the food warming concepts on a common basis, the weight and volume of each food concept includes the weight and volume of the trays and tray rack associated with it.

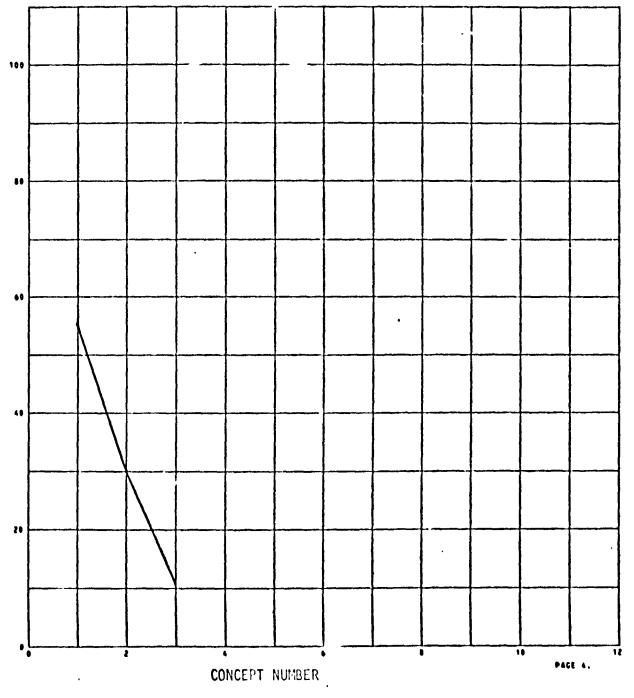
| 11HE ANT. USES/DAY TYPE USED HS/USE 1.1 - KG/USED 3.000 3.000 3.000 | INDER NO. 1.2.2 | : | FOOD BERRING (SPACE STATION) | | | | | | | |
|---|---------------------|---|------------------------------|------|---|---|---|---|-------------|---------------------------------------|
| 1 1000 1 1000 1 1000 1 1 | UNAGE | CONSUMABLES AND | | | ELEC | | | | 0 S T E C T | RESURE |
| 2 3.000 2 3.000 2 3.000 2 3.000 3 3.000 1 10.001 (155.1) 120.0 110 | USES/DAY HRS/USE | AMT. TYPE USED [*) *KG/USE. ILB/USE) | v 9 G | 11.5 | # # # # # # # # # # # # # # # # # # # | | מַסְרָּי | -: | | # # # # # # # # # # # # # # # # # # # |
| 3 3,000 3 1000 3 | 3.000 | | 1 | _ | _ | 60 | - | _ | 'n | - |
| CONCEPT WANK CONCEPT WANK CONCEPT WANK (**) CASH AR (CHROLATED) LITES/SEC (TT ³ /TT) 1 - CASH AR (CISSIDATE) OSCUMPLY CONCESTOR (LECTRICAL MEAT) 2 - CACH AR (LSST) 3 - CACH AR (LSST) 4 - CACH AR (LSST) 4 - CACH AR (LSST) 5 - WITCH AR (LSST) 5 - WITCH AR (LSST) 6 - WITCH AR (LSST) 7 - MITCH AR (LSST) 8 - WATER (CHROLATED) LITES/SEC (TT ³ /TT) 7 - MITCH AR (LSST) 8 - WATER (CHROLATED) RS/TT 8 - WATER (CHROLATED) RS/TT 10 - CASH AR (LSST) 11 - CASH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 16 - MITCH AR (LSST) 17 - MITCH AR (LSST) 18 - CACH AR (LSST) 19 - WATER (CHROLATED) LITES/SEC (TT ³ /TT) 19 - WATER (CHROLATED) LITES/SEC (TT ³ /TT) 10 - CACH AR (LSST) 11 - CASH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 16 - CACH AR (LSST) 17 - MITCH AR (LSST) 18 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 10 - CACH AR (LSST) 10 - CACH AR (LSST) 11 - CACH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 16 - CACH AR (LSST) 17 - CACH AR (LSST) 18 - CACH AR (LSST) 18 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 10 - CACH AR (LSST) 10 - CACH AR (LSST) 11 - CACH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 16 - CACH AR (LSST) 17 - CACH AR (LSST) 18 - CACH AR (LSST) 18 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 10 - CACH AR (LSST) 10 - CACH AR (LSST) 11 - CACH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 17 - CACH AR (LSST) 18 - CACH AR (LSST) 19 - CACH AR (LSST) 19 - CACH AR (LSST) 10 - CACH AR (LSST) 10 - CACH AR (LSST) 11 - CACH AR (LSST) 12 - CACH AR (LSST) 13 - CACH AR (LSST) 14 - CACH AR (LSST) 15 - CACH AR (LSST) 16 - CACH AR (LSST) 17 - CACH AR (LSST) 17 - CACH AR (LSST) 18 - CACH AR (LSST) 18 - CACH AR (LSST) 18 | *** | | | _ | 1247.0 | 0.0591 | _ | | 9 | - |
| CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCEPT NAME CONCENT NAME CONCEPT NAME CONCENT NAME CONC | | | | _ | 7.021# | | - | _ | 33 | - |
| 400 400 (1) AVAILABLE (1) AVAILABLE (2) STATE OF THE ART (3) SGUE DEVELOPMENT REQUIRED (4) EXTENSIVE DEV. REGJIRED | 1 | # 2 | | | - CASIN AIR - CACIN AIR - COLLIG WATER - WATER - WATER - MITCOSEN - MITCOSEN - MITCOSEN - WATER | (CIRCULATED (LOST) (LOST) (CISCULATED (CISCULATED (CISCULATED (CISCULATED (CISCULATED (CISCULATED (CISCULATED (CISCULATED | | (17/13) (18/13) (16/13) (16/13) (18/13) (18/13) (18/13) | | |
| | | | OF POOR QUALIT | | | T REQUIRED REQUIRED | (***)COST INDICATO 0-25% 25-50% 50-75% 75-100% | o' | | |

APPLIANCE CONCEPT NO.

HEATING TRAYS (SKYLAB)

OVEN-HOT AIR CONVECTION (ELECTRICAL HEAT)

OVEN-MICROWAVE (PLAIN)



Food Warming (Space Station) Concept Trade

| | 1 | | | |
|-------------------------------------|---|-------|---------------------------------------|---------------------------------------|
| | .0540 | •1280 | | |
| NUMBER OF DAYS . 180.0 (.49 YEARS) | THERMAL PENALTY - DIRECT TO COOLANT (LG/BTUM) | v | PONER PENALTY (LBS/WATT) TYPE 1 .7109 | POWER PERMITY (LRS/WATT) TYPE 2 .5910 |

| • | | | | | | | | | | | |
|---------------------------------------|--------------------|--------------|-----|-------|----------|-------|---|---|---|--------|----|
| FACTOR | N I N V A L U E | MAX VALUE | PTS | 1- | ~ | | a | Z | U | _ ω | Δ. |
| | 9 | | | 46. | 1. 1. | | | | | | |
| | | 2925.2 | | 12.00 | 11.10 | | | | | | |
| 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0000 | 7.2607 | 01 | 00 | | * | 1 | • | 1 | ; | i |
| HEBRAI | 128.50 | 449.28 | 5 | 02.01 | | 00+ | | | | | |
| DELIAR-Y | . 99537 | .99978 | ď. | 2.09 | | 4.76 | | | | | ; |
| MATERIA | 00000 | 1.00000 | Ŋ | 4.28 | 00. | 4.24 | | | | | |
| SAFETY | 00000 | 1.0000 | v | 5.00 | 00. | • 00 | | | | | |
| Tyo | 5.0000 | 30.000 | 15 | 12.50 | 000 | 00. | | | | | |
| TOTAL PT | 00000 | 65.000 | 9.2 | 46.93 | 25+52 | 9.17 | | | | | |
| RATING | .00000 | 100.00 | 100 | 55.21 | 30.05 | 10.79 | , | | | | 1 |

SENSITIVITY ANALYSIS

| | 20 | : |
|------------|-----------|------------------------------|
| 9 | ₽ ₹ | |
| ー・マンとノと | FACTOR | |
| 47.14 | GHTING | P011:15) |
| 1000 | ER MEI | × TI |
| 00 = 5 | RAMET | 100 |
| <u>.</u> | 4 4 | ő |
| MATING FOR | SELECTION | I BASED ON 100 S MAX POINTS) |
| _ | SINGLE | - |

| | SINGLE | SINGLE SELECTION | PARAMETER MEIGHTING FACTOR BY ON 100 S MAX POINTS) | 05, |
|---------------|--------|------------------|---|------------|
| | • | | : | ł |
| | | | | |
| - | _ | ~ | | |
| NORMAL | 55.21 | 30.05 | | ٠ |
| BEIGHT | 59.93 | 39.40 | 26.6 | 1 |
| P O % E M | 57.22 | 33.62 | 9.92 | |
| ▼OLUME | 52.14 | | 10.27 | |
| THERMAL | 56.51 | 31.67 | 0.92 | |
| RELIAB-Y | 54.82 | 29.20 | 13.20 | |
| MAINTENC | 56.07 | 29.20 | 12.93 | |
| SAFETY | 56.49 | 29.20 | 10.48 | ! ! |
| DEV COST | 57.49 | | 9.92 | |
| | | | | |

ORIGINAL PAGE IN OF POOR QUALITY

| | Ī |
|---------------------|---|
| | EACH CONCEPT AFTER INCREASING PARAMETER WEIGHTING FACTOR BY ON 100 S MAX POINTS! |
| 1 | AFTER GHTING POINTS |
| 01013414 A.I.I.I.I. | NG FOR EACH CONCEPT AFTER INCREASING ECTION PARAMETER WEIGHTING FACTOR B TORACED ON 100 M MAX POINTS! |
| | E A A S |
| | RATING FOR SINGLE SELECTION |
| t | i |

| | • | | | | | | | | | |
|---|-----------|--------|--------|-------|--------|---------|----------|----------|--------|----------|
| | - | | | | | | | | | |
| | a. | | | | | | | | | |
| | e. W U | | | | | | | | | |
| | U | | | | | | | | | |
| | z | | | | | | | | | |
| | 0 | | | | | | | | | |
| | U | | | | | | • | | 1 | |
| | r) | 64.01 | 11.84 | Œ | 11.38 | 11.84 | 9.24 | 8.53 | 11.12 | 11.64 |
| | ~ | 30.05 | 29.65 | 25.80 | 30.40 | 28.12 | 30.97 | 30.97 | 30.97 | 32.96 |
| | - | 55.21 | 63.32 | 52.81 | 54.66 | 53.65 | 55.61 | 54.29 | 53.85 | 52.49 |
| • | | NORMAL | #E16HT | #0:EB | VOLUME | THERMAL | RELIAB-Y | MAINTENC | SAFETY | DEV C35T |
| : | į | i | ; | | ı | | | | | |
| | | | | | | | | | | |

73595

 \dot{C}

()

| ORIGINAL OF POOR | L PAGE IS |
|---------------------|-----------|
| 0 | |
| • | |
| | |

| | - | | | : | | | | | | | |
|------------|--------------|---------|------------|---------|---------|----------|----------|---------|------------|----------|----------|
| <u>.</u> | • | | | , | | | | | | | |
| t | W | | | i | | | | | | , | |
| , | 7 | | | ! | | | | | | 1 | |
| | z 0 | | | | | | | | | ; | |
| ; | Ü | | | | | | | | | ļ | 4 |
| • | • | 60. | 00. | 77, | 00. | 4 - 75 | 4.24 | ٠٠٥٠ | <u>.</u> 0 | . 9 - 17 | 10.79 |
| | ~ | 5 - 1 4 | 11.10 | 1 4 4 1 | 7.50 | 00. | 00. | CO. | 00. | 55152 | 30.05 |
| 743 | 1- | .36 | 12,60 | ດ ເວ | 10,70 | 2.C6 | 4.23 | 5.03 | 12,50 | 46.90 | 55.18 |
| (12/09/74) | P 15 | 15 | 15 | 01 | 5 1 | S | 'n | w | 15 | 58 | 100 |
| | MAK VALUE | 12**03 | 292502 | 7.2000 | 449.70 | .99772 | 1.00000 | 0.0001 | 36.000 | 000+S8 | 100.00 |
| | MIN | 61.500 | 5.85 . i ? | 5.9000 | 128.90 | 15156 | 65066 | • 60000 | 5.0000 | 00000 | • 00000 |
| | FACTOR | AE 1641 | POAER | VOLUME | THEGMAL | REL148-Y | HAINTENC | SAFETY | DEV COST | TOTAL PT | - BNILVE |

73501

 \mathbf{C}

(

 \boldsymbol{C}

(

| 5 |
|--------|
| |
| S |
| > |
| 2 |
| ₹ |
| ž |
| à |
| _ |
| |
| |
| > |
| - |
| = |
| V 1.1 |
| IVIT |
| TIVIT |
| ITIVIT |
| TIVIT |

SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY 50 %

0 N C

16.6

50.10

RE 1GHT

O

52.11 56.48 54.78 56.46

56.04

RELIABAT Haintenc

(``

SAFETY

30.05

55.18

(

SENSITIVITY ANALYSIS

SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY #50 STREET (BASED ON 100 S MAX POINTS)

4 3 U % O

11.83 11.83 10.79 8.23 29.65 25.80 30.08 13.60 28.12 55.18 40.28 52.77 58.63 53.62 55.63 RELIAN-Y HAINTENC DEV COST MORMAL T 4ERMA SAFETT BADTOA REIGHT POAER

Dat any

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 1.2.2-FOOD WARMING

CRITICAL M.MBER OF STREETY **⊢** w z. 0 a ≅ 0 ပ LL, 0 α ш TIMER CONTROLLER æ Σ) Z вь. сем. **ЯЗТА**ЭН вгомев **80T0**:1 COMPONENT TYPE HOT AIR CONVECTION (ELEC. HEAT) (pg. 5-2) *Derated to I due to low temperature of three ht's. MICROWAYE (PLAIN) (pg. 5-4) HEATING TRAYS (SKYLAB) APPLIANCE TYPE

1, , ,

SPACECRAFT Space Station

HABITABILITY SUBSYSTEM Good Congress HABITABILITY FUNCTION Food Proposition

APPLIANCE FUNCTION Food Marring .

APPLIANCE CONCEPT NO./TITLE 1/Heat Travs (Stylab)

INDEX NO. 1.2.2.1 REF. NO. 265, 276

DESCRIPTION: In this concept, an insulated feed tray with three heating cavities surrounded by imbedded electrical resistance heating elements it used. This concept was used on Skylab, and the actual Skylab reight/volumy/power data were assumed. A heating like of P. to 2 hours is required to warm the food. Two hours was used for computing themsal penalties to the cabin coeling circuit.

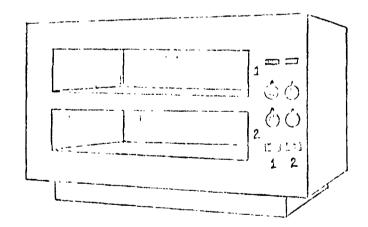
Each Skylub heating tray weighed 10.9 kg (24 lb). However, of this total weight, 2.7 kg (6 lb) was a stainless steel brack it used for a working surface. To compare with the oven concepts, the weight/volume of this bracket was not included in the heating tray weight/volume. Instead, the data for a tray storage rack was taken from Reference 276 and added to the basic concept weight and volume. No separate dish tray penalty was added for this concept since the tray is already an integral part of the concept.

| concept 1 1 | APE: 175 | GE C (1) # 1 # | Emiliental, P | HWOHE O | o Atley, Index | N MER (| |
|--|------------------|--|-------------------------------|--|--|------------------------------------|---|
| | F + 1 C T | FILAL | POWER | REQUIFE | M | | |
| | 1710 | | . A C P 0 V t | · · · · · · · | | | ŧ. |
| Compensation (REF) | CYCLE (HR) | (MVIL2) (S) | AVERAGE (WATTS) | (A) (pr () () (wr () - m// (r () t () (l) x () | (5) PEAR (WATTS) | (6) /VEP/ E | (7) Minor (Wint) Critty (1) X |
| | | ****** | | | ''''' | | |
| *** *********** | | promote record to the | | | | •••• | • |
| | *** *** * **** | | - | | · | | |
| gradings at the control of the contr | | | | | | | |
| *** | | | | | | | |
| | | | | | ********** | | |
| | | MAXIMUM | · · | JATOL | MAXIMON | | |
| | | | | | | | , |
| | ŕ | | | | | | |
| | | I H E K M A I | L' <u>R</u> EQUI | BEMENIS | | | |
| SOUPCE | | LATENT (BTU/HE) | | BTLFE | HEAT LEAK (BTU, 112) | | C 608 557 |
| <u></u> | . | <u>()</u> | | | | | |
| The second secon | | | | | Republished to govern | • ••• | |
| *************************************** | | | | | | | |
| | | | | | - | | |
| | **** | ··· ·· · · · · · · · · · · · · · · · · | | | | | - |
| | TOTAL | | | | | | <i>!</i> |
| | | NATE (ETU/HE | | (BTU/FR) | WATT (BTH/HR) | WATT | (B) 744 |
| • | | • | | | • | | |
| | | | | | | • | |
| | ō | PERAII | ONAL PE | N <u>A L T 1</u> E S | | | |
| | | THERM | | ELECTRICAL | NE IGHT | , V | OLUME |
| SOURCE | HEAT (BTU/HP/ | LEAK CYCLL) | TO CONLINT (BTU/H//CYCLE) | (PK WATTS/CY | | | \m1281() |
| | | | | | • | | |
| Birth Charles Communication of the spin of | | | | | | | |
| - | | | | | | | |
| Part of the speciments and a second community and | | | | #****************** | | • | |
| · | | Territorio agravi della di | | - | The same and the same and | | |
| | | | | | | | |
| . 10 | | CAUTE . | WATER CYCLE (BTU/HE/LY LE) | · · • · · · · · · · · · · · · · · · · · | ###################################### | ης Τ <mark>μ</mark> ής (%) (FT) | NAT2216-A) NAT2-1 - P |

| | <u>F J Y E h</u> | уг 15 ит. | \A € F u .a.t | 8 1 Q U 1 | FIMENTS | |
|--|--|---|------------------------|---------------------------------------|--|---|
| COMI GLEVI | -(REF) | | VETO (LES | (ī 5) | | (FI,) AUTILE |
| | | | | | a and the same | - ' . |
| | | | | | • • • • • | |
| | | | | | | |
| | | | | | | |
| | | | | | | · |
| | | | | | e a serie de la | |
| SINAL PAGE IS | TOTAL | | | · · · · · · · · · · · · · · · · · · · | | · ·-····· · · · · · · · · · · · · · · · |
| POOR QUALITY | , | . • | KG (11 | 5) | / t ann - / | M3 (F(3) |
| - | <u>5 0 L 1</u> D E X | | | | QUIPEMENTS | , |
| TYPE | UNITS/CYCLE (PE+) | (\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ |) ([FF] [)(+EF) | (re) (re) (re) | (4) VOLANTE (FEE) (FEO.VOLANTE)(FE (FE) | (N) VOL/(1) (1) Y (1) (+1) |
| | | | | | ************ | |
| | | | | | ************************************** | |
| | **** | | | | | |
| Milliante de la compansión de después des el | Provide place of the contract of the experience on | | | | | |
| | | | ∑ () | AL m /(+ 1 E (LB) | Σ | 5) TOTAL V((FT) |
| CAC LMI2/11/2 | LESYLAY D | MSWIE IEF | . X . — 101.W | | • | |
| TOTAL YOU MISSION | | , | (| LB) | | |
| CYC | ou Ar X | AYS/P15Jte#T | v.10f. X) | PI '} | · I | T'MF (FT*)" |
| | <u>6 A 5</u> /L 1 Q U 1 I | э ейьб | N D A P L E S | <u>R</u> f Q t | IIPEMENTS | |
| TYPE | AMT.USED/ | (FE) | RECOVER FACTOR | 7 | MI.RECORDO 7/CYCLE WY (2) (LE) | AMT 10:1/0: (1.6) (1.6) |
| *************************************** | | | | | | |
| | er de la quaestra des la description de la descr | | | | | |
| | | | | | | |
| | Σ ① | | | | Σ. | |

| SPACECRAFT_ | Space Station | | - • | • | |
|-------------|---------------------|------------|---------------|------------|------------------|
| HABITABILI | TY SUBSYSTEM Food F | ianace ent | _HABITABILITY | FUNCTION_ | Food Proparation |
| APPLIANCE I | UNCTION Food War | ming : | | | |
| APPLIANCE (| CONCEPT NO./TITLE | 2/0vcn-ho | t air convect | ion electr | ic |
| INDEX NO | 1.2.2.2 | | _REF. NO | 276 | |

DISCRIPTION: This concept resembles a conventional electrical oven with resistance heating elements. Oven size is based on the requirement in Section 1.2.2 of 0.0209 cu m (1.02 cu ft) of food per meal. A heating time of 0.5 hours was used, with an additional 0.5 hours allowed for the oven heat to dissipate to the cabin gas. Thus, a total time of 1 hour was assumed for computing the thermal penalty to the cabin cooling circuit.



| CONCIPT | | A CONCESS OUT OF | (* 1741 * <i>17</i> 41) } | TOREIRS CALC | INDEX | NUMBER | . ~ |
|--|---------------|--|---------------------------|--|----------------------------------|---------------------------|---|
| /1 · · · | ELECI | RICAL P | OWER | ri dul Ki | H <u>L</u> N] § | | |
| | | A C | PONE | k | b (| POWE | f. |
| omorara (REF) | CYCLE (HP) | DEVA (5) | (3) (3) | (4) (WALL 1897 (WALL 1897) (1) Y (5) | (5) PEAL | (NATTS) WASHING | (1) x (7) (1) x (1) (1) x (1) |
| 4 | <u></u> | No. of the Control of | | | 1 | <u> </u> | .11.1 |
| | | a grand of the same | | | | | |
| | | | | | | | |
| | | A special feature of the | | | | | |
| professional and a second results of the sec | | | | | | | |
| | | | | | AND THE PERSON NAMED IN | pagestray distances are a | |
| | | | | | | | |
| | | • | , | | | • | |
| | | | • | | 40 | | |
| | | MAXIMUT | • | TATOT | MAXIMUM | · | TOTAL |
| • | | | | | | | , |
| | • | | | | | | |
| | | | • | | | | |
| Soupce | | LATENT (BTU/HR) | (810 | 7 / 1788) 1816: | (BTU/HE) | | COOLANT BTU/HF) |
| <u> </u> | | | , | - / | 1 | | |
| | | | | | | | |
| | • | | | | | | |
| k allege in Associatific anadomatic sets in its discovering and allege in the | | and the second s | | THE COMMERCE OF THE COMMERCE O | | | |
| | | | | | | | |
| | | | | | | | |
| | TOTAL | 1 | F , = , | ,> | r . · · | • | ! |
| | 10174 | WATT (BTU/HR) | | BTU/HR) | WATT (BTU/12) | WATI | (BTUVHE) |
| | | • | | | milit (010) | , , , , , , | (inter) |
| • | | • | | | | | |
| | | | | • | | • | |
| | | | | | | | |
| | | | | • | | | |
| | <u>o</u> | PERALLON | AL PE | NALTIES | | | |
| • | | THERMAL | | | | • | |
| | HEAT | LEAK TO | C00F V.1.1 | ELECTRICAL | KE1GH. | | VOLUME |
| \$0 URCŁ | (BTU/HR/ | CICLE) (ETU) | HR/CYCLE) | (PK WATTS/CY | CLE) (LB/HISS) | ION) (FT | 3 \W12210H |
| · , ' • | | | ٠, | | • | | |
| | | | | | | | |
| | | | | | | | |
| - | | | | | | | |
| | | | | | | | ······································ |
| | | • | , - | | | • | |
| Makana midhi garaga ni migi ai di padali i sapini ni terbu | | · ************************************ | | | gate not proposed as a different | | • |
| | TOTAL | | - | | | | |
| | WATT: | SZCYCLE WAT | TS/CYCLE | | KG/M15.51 | ton H3 | VILLERIOR |

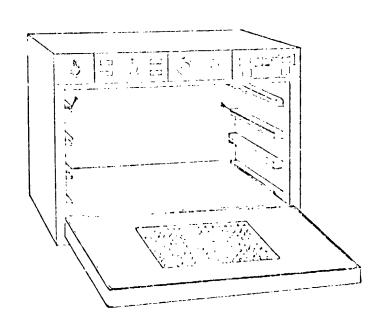
| | <u>F.J.X</u> | ED ÅFTC | | E REQ | U 1 P F M E M I | <u> </u> | VOL tIME |
|------------------------------|--|------------------|------------------------------|--|----------------------|-------------------------------|---|
| COMPONENT | | (RLF) | · | (LES) | | | (fi [*]) |
| pagament of the same time to | | | | | | | |
| | | | | | | | |
| | | | | • | | | |
| | | | | | | | |
| | | | | | | | |
| GINAL PAGE | 18 | TOTAL | | ′ 1 | | . , . | (/ |
| POOR QUAL | YT | | K | (LES) |) | , P | 1 ³ (FT ²) |
| | <u> </u> | EXPENDA | | | EQUIREM | | , |
| | 0 | (PKG.WT | Ňικία)(EEF) 13 (LEL) ⑤ | MI/CYCLE (LB) | VOL /UN (PKG. VOL | (4) 11 (ptr) 2011)(ktr) | (5) VOL /CYCLE (1) Y (4) (E13) |
| TYPE | | E(REF) | (LE) | (LB) | (F | T ³) | (813) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | despendent of the server of the |
| | | | Σ3. | | | Σ \mathfrak{G} | TATAL TUO NON |
| דהדאו עיד | | | | 101AE RT/CYI (LB) | JLE | | TOTAL VOL/CYC |
| TOTAL KT MISSIN, - | CYCLES/UAY) | DAYS/HISSI | on X | Ollwizuycie (LB) | | | G (LU) |
| TOTAL VOL | , | (| x | | | | |
| | CYCLES/DAY | DAŸSYMISSI | ∪N 1 | 01.VUL/CYCLE (FT3) | · · | М | (117) |
| | ************************************** | 0110 54 | D f N D & D I | F C D P | QUIREME | u T c | ٠ |
| . , | <u>G A S/L I</u> | Q ARTA EV | PENDABL | () | AMT. RECOVERED | | AMT LOSI/CrC: |
| T | YPE , | .USED/CYCLE (REF | 1 , | OVERY CTOP | (LB) | /CYC! E | 0-(3) (LB) |
| | | • | | | | | |
| | | | | | | | |
| | | | | gan de sant de la companya de la com | | | |
| | Σ ① | | | | | Σω | |

| SPACECRALT, | Space Station | | |
|--------------|------------------|---------------------------|--|
| HABITABILITY | SUBSYSTEM Food 1 | lanagery nt _MARITABILITY | FUNCTION Food Preparation |
| APPLIANCE FU | MCTION Food Man | ming | and the state of t |
| APPLIANCE CO | MCLPT NO./TITLL | 3/Oyen-Microwave | and the second s |
| TUDEX RO. | 1.2.2.3 | RL1. NO | 276 |

DESCRIPTION: This concept resembles a conventional microwave oven. Oven size is based on the requirements described in Section 1.2.2 of 0.0289 cu m (1.02 cu ft) of food per meal. A heating time of 10 minutes was assumed, with an additional 0.5 hours allowed for the oven heat to dissipate to the cabin gas. Thus, a total time of 40 minutes was assumed for computing the thermal penalty to the cabin cooling circuit.



Tray Restrents



| CONCEPT | | WE CONCEPT FEQU | The Mark Fate | HENNELHES CALC | | Name of A |
|---|--|---------------------------------------|-----------------------|---|---------------------------------------|--|
| Contern | | | | | 160.3 | timps P. T |
| | ELLC | TELCAL | POWFR | P. F. Q. O. I. R. F | пенть | |
| | | ^ | C PORE | P | 0.0 | POWER |
| Composite (REF) | (HP) | (E) PEAK (WATTS) 2 | (WATTS) | (4) D(17/36) (84) 1 (19/ C((.1)) (1)) (3) | (S) PEAK (WATIS) | (6) (1970) AVERAGE (WALLE) (WALLE) (1970) |
| | | nante e trensman | | | | The stage of the s |
| | magnification and an experimental | Marine - marine and | | | | |
| | | | | | | |
| | | | | | | |
| Propogramical committees of a Marian service of Asset de Asset service of | | | | , | | Personal of Contract |
| | * | | * | | el arriferiar signi qui generalizza e | A STREET, ST. ST. ST. ST. ST. ST. ST. ST. ST. ST. |
| | | MAXIMUM | • | TOTAL | MAYIMUM | JATOT |
| • | | , | | | | , |
| | • | | | | | |
| | | | | • | | |
| | | IHERMA | REQUII | REMENTS | | |
| SOURCE | | LATENT (BTU/HR) | | Mar) Plete | (BTUYHP) | TO COOLEST (BIU/HF) |
| | | | | | 17 17 11 | .5 |
| | | | | | | |
| **** | | | | . | | - |
| BOT COLOR TO THE AND THE STREET AND | | | | | | |
| | | | | -, | | en e www.un |
| | JATOT | | | 1. | 1 | , |
| | | WATT (ETU/HR) | WATT (| BIU/KR) | WATT (BIU/HR) | WATT (BTO/NE) |
| • | | • | | | | |
| | | | | • | | • |
| | | | | | | |
| | į | <u>DPERATIO</u> N | Ϋ́I ΡΕ | NALIIES NALIIES | | |
| SOURCE | HEAT AH\UTB) | THEPMAL I LEAK 10 /CYCLE) (BTU | COOLANT YHRYCYCLE) | ELECTRICAL (PK WATTS/CYC | WEIGHT (LB/MISSI) • | VOLUME ON) (FT ³ /C 1551043 |
| | | * * * * * * * * * * * * * * * * * * * | | | | |
| | and the second s | | | Angustation is gone was tree. | | |
| } | | mare or a deducation of the second | | *********** | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | the state of the s |
| | TOTAL WATT | SZCYCLL WA BEZCYCLL) (161 | TTE CYCLE) | | KG/M15510 (LB/M15510 | क्ष) (FT 78155164 अ) (FT 78155164 |

Art Barrier

| HABITALILITY SUPSYSTEE1.0 | Food Margrey ort |
|-------------------------------|-------------------------------|
| HABITABILITY FUNCTION 1.3 | Cleancy |
| APPLIANCE FUNCTION 1.3.1 | Pichwash r/Degree Combination |
| NUMBER OF CONCEPTS CONSIDERED | 10 |

ASSUMPTIONS

All the automatic dishusshing data found have been for single integrated washer/dryer units. Three washings per duy were assumed, with 6.8 kg (15 lbs) of water used for washing and 6.8 kg (15 lbs) for rinsing. It is assumed that 0.14 kg (0.30 lb) of residual water remains on the dishes after washing to be removed by the dryer.

The amount of dishes required by the crew, assuming an automatic dishwasher/dryer is abound, was computed and included with the washer/dryer penalty. This was necessary to compare with the disposable dishes case in Section 1.3.2. The packaged weight and volume of the dishes were taken directly from Section 1.3.2, and the results shown in Table C2-5. The total dishes/utensils/cups required with the dishwasher for a six-man or w is 6.9 kg (15.2 lbs) and 0.023 cu m (0.81 cu ft).

Washing tire and drying time are each assumed to take one hour.

TANCE CONCEPT FUNCTION MATRIX

**** OISK BASKER/DRYER COMBINATION ISPACE STATION)

1...

| | 1145 | • | | | | , , | , | 1 | * < | | | ۱ د د | 3 | | | 08.6437 0357 | 1 1 1 | , |
|------------|---------------------------------------|---|---------------------------------------|---------------|------------|------------|---------------------------------------|--------------------|--------------------|---------------------------------------|----------------|-------------|---|----------------------|-----------|-----------------|-------------|---|
| , | USES/DAT MRS/USE | | # # # # # # # # # # # # # # # # # # # | 1014 | I SOO | | # # # # # # # # # # # # # # # # # # # | | C00CBN1 1481151 | # # # # # # # # # # # # # # # # # # # | | 4 | - - - - - - - | H VOLCER H COLCER | 7 7 7 | A16 1058 W | • | \$ 6 6 \$ 1 1 0 \$ 2 2 2 2 \$ 22 2 3 \$ 24 3 \$ 34 6 34 6 34 6 34 6 34 6 34 6 34 6 34 6 |
| - | 0000 0000 0000 | • | 1 3-CGC | | | 50 | | | 0.0 | 371. | 150.0 | u o | 7 | | 7 | 5 | _ | F |
| | 3.900 | • | 13-6-80 | .00. | = | 0.0 | 9 0 | - | 00 | 1351. | 1350.0 | 00 | 151.51 | 875 53 (26.53) | • | 0.4 | - | , i |
| ~ | 000 7.000 7.000 | • | 13.67.0 | 500 | ~ | င်င့် | 0.0 | _ | 247: | 371. | 167.0 | 60 | 81.5 | 9 4 6 | n | ν) El | - | 4.4 |
| · ~ | 3.00.0 | • | 13.6090 | 1 000 1 | : - | e e | 1 | _ | 331.1 | 369. | 174.0 | 000 | 77.8 | 8 .75 61 (27:C2 | in | 75 | · • | 7.7 |
| • | 3.000 2.000 | ٠ | 13.6089 | 200 600 | - | o e | 0.0 | _ | 13.2.1 | 255. | 166.0 | n () | 9-,3 | 3 (26.00 | n _ 7. | 75 | - | 7 . 7 |
| • | 3.000 | • | 13.6090 | 65. | 1 - | 6 <u>6</u> | | | 66 | 6131 | 72.0 | 0.0 | 82.4 | 72 | - m | 56 | - | , Ū |
| | # # # # # # # # # # # # # # # # # # # | • | 13-6-60 | B.D. | _ | 6.0 | ů. | - | 244 | (21212) | 257.0 320.0 | 0.0 | E 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | 3 .74 | n | \$5 • | - | , |
| • | 3.000 | - | 13.6760 | 100 | • | ρĈ | 00 | و دة | 67. | 5774 | 250+0 | 9.0 | 86.5 | 1 28:0 | € 60 | 15 | - | 7 4 7 1 |
| • | 3.000 | • | 13.6573 | 000 | - | 6.9 | 6.0 | _ | 353. | 255. | 250.0 | ο̈́ο | 107.3 | 3 ,74 | | 75 | - | 7.4 |
| 9 | 3.000 | • | 13.6680 | 500 | - | 00 | 00 | - | 59. | 11200+) | 22.0 | 0.0 | 49.3 | 3 3 | <u>ר</u> | - 35 | - | h () |

ENAL PACE A

Contraction of the Contraction o

```
25-50$
(1) AVAILABLE
(2) STATE OF THE ABT
(3) SOFE CONELOWENT REQUIPED
(4) EXTENSIVE DEV. REQUIRED
```

C2-70

 C_{i}

```
APPLIANCE
         CONCLET
                        CONCEPT NAME
           110.
                      HOT WATER SPRAY-CERT IF HTE OFFITAS
                      HOT HATER SERAY-FIL SHEET DET
                      HOT HATCH SPRATHED COD HOT ATRICESCTITCHEAT DRY
                      HOT WATER SPRAYER STOLENT ELECTRICALLY DESCRIPTION HOT WATER SERAYER STOLEND HOT AIR COVETHERMAL STORAGE
                       ULTERSOITE WAS MACENTHIFUSE OFFINA
                       ULTRADUITE PARAMENIC TO HET AND DEVING
                - ULTRASCRIC RASH-FORCED ROTED DRY ATF-DEFICEART, FLECTRICALLY DESCRIBED - ULTRASORIC RASH-FORCED HOT AIR DRY-THERMAL STORAGE
            9 - ULTMASONIC MASH-FONCHO MAT I
TO - MANUAL MASH-MANUAL MIRE DAY
:00
80
..
46
20
                                                                                             10
                                                                                                     PAGE 1.
                                       CONCEPT NUMBER
```

Dishwasher/Drver Combination (Space Station) Concept Trade

ORIGINAL PAGE IS OF POOR QUALITY

| | SELECTION MATRIX | = | (02/01/75) | • | 7# #S#0 | SHER/OR | YER COH | 012A710 | DISH WASHER/DRYER CORBINATION (SPACE STATION) | STATE | 20 | | |
|-----------|------------------|-------------------|------------|----------|-----------------|---------|---------|----------|---|----------|-------|---------|-----------------|
| | ₹ 1 | ¥ | | | | | 2 | 8- GL | | | | | |
| ACTOR | VALUE | VALUE | PTS | ; - | 7 | • | | | • | ^ | | • | 0 |
| E 164T | 106.54 | 236.57 | <u>.</u> | 4 . 4 5 | 5 . 3 9 | 3.61 | 4.12 | 1.39 | 3.49 | 2.66 | 2.03 | : : | #\ 60 |
| 1 H H C | 55.379 | 4 - 2001 1 - 1 | 5 | 12.74 | 00. | 70.07 | 11.77 | 12:39 | 11.71 | 6.5.0 | 11004 | | F |
| 3 4 1 4 E | 15+303 | 72.500 | 2 | 1 . 2 5 | 4 m | 1.25 | .n | . 7.1 | 6. (7 | • 7 ! | 0 | r. | T |
| Tradiu. | 162.33 | 550+34 | וח | 60 | Cū. | 5.72 | ,n, • C | 10+33 | 6.13 | 10 10 | 7.53 | 10.03 | • |
| ELIA: +Y | 1936E+ | .93772 | · S | ν υ•• | 70.0 | 3.57 | 3.53 | 0.6 | m 1 | C | (, | , () | () () • t |
| DABLARA | 6: .05. | 00000 | 'n | 3.0 | 3.67 | 3.17 | 3.13 | | \$ 4 . | е Б | • | | , r. |
| A:34V | • 20000 | 3.0000 | 'n | 3,33 | 5.00 | 1001 | 3.33 | 1 • 5 7 | 1.67 | © C • | _ | · (1) | 0.00 |
| EV COST | | 75.013 | 5 | 2.53 | 3+00 | 5.03 | 0 | 20. | C)• ; | 7.37 | 00 | r | F) (F) |
| OTAL PT | • 66330 | 000•69 | F 5 | 42+73 | 21143 | 33.30 | 36+01 | 33,33 | 27.53 | 21.79 | 22.63 | 22014 | * 1. * 5 S |
| BATTA | 00000 | 100.30 | 100 | 50.47 | 100 50.47 25.22 | 45.12 | 12.5 | 39.18 | 45.12 43.31 39.18 32.74 25.63 26.66 26.43 | 25.63 | 36.65 | 26.43 | 70.03 |

| S | |
|---|--|
| • | |
| S | |

SINGLE SELECTION PARAMETER ARIGHTING FACTOR BY SO & CRACED ON 100 & MAX POINTS.

| | • | | | 2 0 U | C E P 1 | | | | | | |
|-----------------|-------|-----------------------------|-------|-------------|-------------------------|---------|------------------------|-------|-----------|-------|---|
| | - | 2 3 | | . | · da | • | ^ | • | • | 0 | |
| LORMAL | 50.47 | 25.22 | | 43.31 | 45.12 43.31 39.18 32.74 | 32.74 | 25.63 | 26.68 | 25.40 | 70.05 | |
| BEIGHT | 0. | 16.39 | 43.42 | 42.02 | 36.75 | 1 9 7 | 54.99 | 26.39 | 2 - + 2 6 | 68.83 | 1 |
| # U F C & | 53.2 | 23.17 | 47.66 | 46.21 | 42.70 | 5 + 4 2 | 26.57 | 67.00 | 33.57 | 72.03 | |
| SHOTOA | .6.3 | 6 24.11 43.31 41.10 37.40 D | 43.31 | 41.10 | 37.40 | 10.4.2 | 24.50 75.20 25.1 68.63 | -5.20 | 250; | 63.63 | |
| THEBHI | 52.25 | 23.17 | 46.72 | 45.45 | 41.53 | 2 · 1 | 27.31 | 16.62 | 23.84 | 70.22 | |
| PEL:139 | 51.3 | 26.69 | 45.67 | £ 7 • C 3 | 11.5% | 2,03 | 24+50 | 20.52 | 25.66 | 70.62 | |
| PAINTENC | 51.1 | 26.59 | 45.66 | 43.57 | 56.35 | 2 + 67 | 24.53 | 25.52 | 23.65 | 70.30 | |
| SAFETT | 50.4 | 27.35 | 64.79 | 43.57 | 39.01 | 2.75 | 05014 | 75.05 | 19.53 | 70.51 | |
| P 2 C 2 C 2 C C | | 40 | | 6 | | • | | | | | |

SENSITIVITY ANALYSIS ...

SINGLE SELECTION PADAMETER ABIOMING FACTOR BY MSD (BASED ON 100 & MAX FOLUTS)

| , | SINGLE SELECTION TAXABLES ARIONITAS FACION BY 450 M 100 K MAX FOLLITS) | 1 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | (BASED ON 100 & MAX FOLVES) | 7 7 7 00 A T A A | R FOILT | 5) | Λ Ε | . | | | |
|---------------|--|---|-----------------------------|---------------------|---------|------------|---------------------|----------|-----------|-------|---|
| , | | i | | 0 | 1 H | | 1 | | : | | |
| | - | ~ | n |) | | • | , | • | • | 6- | |
| NORTH P. | 59-47 | 59.47 25.22 45.12 43.31 | 45.12 | 43.31 | 37.18 | 32.74 | 25.63 | 26.68 | 26.40 | 70.05 | |
| BFIGHT | 52:16 24:18 .7:14 44:74 4 | 24.18 | .7.14 | 7 ° 3 | 7 - 7 | 33.66 | 26.39 | 27.38 | :8.95 | 71.51 | ļ |
| #34E# | 47.13 | 27.56 | 42.62 | 39. | e ; | \$ L • B & | 28.15 22.01 22.12 ; | 22.12 | . 1 • 43 | 07.50 | |
| VOLUME | 52.84 | 47.41 | 47.16 | | 9 | 34.73 | 25.79 | 24.34 | £ 4 . 7 . | 71.59 | |
| 14-63-1 | 44.33 | 27.56 | 43.72 | | .3. | 30.46 | 69.63 | 21072 | :2.29 | 5: 69 | |
| MFL 148-V | 49.52 | 23.65 | *** | | 8 | 33044 | 7 | 27.49 | 21.6 | 57.69 | |
| MAINTENC | *** 78 | 23.7. | | | 2 . · K | 33.16 | 26.42 | 67.51 | : 7 - 1 9 | 67,58 | |
| SAFETY | 40.06 | 22.95 | • • • • • • | 42.60 | 9.35 | 37.72 | 26.41 | 13 . e B | :7.23 | 69.13 | |
| SEV COST | 54.04 | 25.72 | | 47.50 | 2002 | 35.27 | 26.02 | 29.26 | 64.65 | 7::57 | |

ORIGINAL PAGE IN OF POOR QUALITY

COCLANT (LB/BTUH) ...
[T LEXK (LB/BTUH) ...
PE 1 ... 7100 26.0 (5.30 YEARS) THEAPL PENALTY - CASIN HELT LEAK POAEM PENALTY (LES/AATT) TYPE 1 POAEM PENALTY (LES/AATT) TYPE 2

SECTION OF THE SECTIO 19+33 21.79 27.62 12.33 ŧĸJ 5.03 20.48 76.0000 3.0000 75.000 **esses**. 100.00 . 27.27. 106.5° 55.85% 15.300 .00000 34.710 17.510 A L C E 167.35 .00200 00000-DEN COST REC COST TOTAL PT 246574 FACTOR RATING

DISH HASHER/DRYER COMBINATION (SPACE STATION)

SELECTION MATRIX

(02/01/75)

| | | 35 | ENSITIVITY | | AMALVSIS | | ; | , | , | | , , | | ; | : | 1 | : |
|--|---------|-----------|--|--|-------------------|---------------------------------------|---|--------|--------------|--------|-----------------------------|---------------------------------------|-----|--|--------|------|
| | 319#15 | ATI | DR EACH | EACH CONCEPT AFTER PARAMETER WELGHTIN DH 100 % MAK POINÉ | | INCREA FACTO | 25 E E E E E E E E E E E E E E E E E E E | | | | | | | | | |
| | | , į | | 2 0 | - A W | f . | | , | ! | • | | | | O | | |
| KORMAL | 42.43 | 20.08 | 37.73 | 36.18 | 32.46 | 27.62 | 21.79 | 22.68 | 22.42 | 54.25 | \$ | | FOO | LIGIN. | · | |
| 1 11011 | 41.77 | 21.03 | • | 35.57 | 0 - | 27.31 | 21.51 | 4.2 | 8.0 | | - | ! | # Q | L I | . ! | t ! |
| ACI CAE | | | 5 | 9 | | 26.73 | 0.0 | 4 | W | 8 .5 | i : : ! | i | UA | PAG | | |
| ************************************** | 41.52 | , o | 2 6 2 | 6.7 | | | 2 - 1 | 2 | 2 - | , . | | | | E | | |
| MAINTENC | 43017 | 1.7 | 4.7 | 6.4 | 7 1 | 27 - 15 | 1.2 | | 1 . 6 | re 🔨 | : | , | | B | • • | |
| DEV COST | 20 · CO | | | | 20.40 | - 4 | | | 60 40 | ₩ ~ | | | | may 4 , affice description — description — | | |
| , , | | | i | , | | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | † † † † † † † † † † † † † † † † † † † | | | : : | Dain |
| | 1 | S | SENSITIVI | ÎTV ANALY | LYSIS | | | | , | | | | | | | |
| | SINGLE | STLECTION | SE SE SE SE SE SE SE SE SE SE SE SE SE S | EACH CONCEPT A PARAMETER WELL ON LCO B MAK 3 | A SETTER SOUTHING | FACTO | 8 T N G Y G Y S G | | | | | | | : | | 1? |
| Ī | ŧ | | | 2 | F 4 9 | | | ì | 1 | | | | | | | 1 |
| * | • | ~ | - | • | | ** | ^ | • | | 0 | | | | 1 | | |
| THEON | 42.43 | 20.88 | 37.73 | 36.10 | 37.48 | 27.42 | 21.70 | 22.68 | 25.42 | 54.25 | | | | | | |
| POSER | 20.48 | | A.8 | | 34.58 | ~ S | 18.44 | \$. Y | 7.4 | | 1 | 1 | ; | | • | |
| AOLU*E | | 21.70 | 30.05 | 37.89 | * (| 4 | | | - | 0000 | ! | | | | 1 | |
| THE RMAL | . ; | | 5 · 5 | 7 4 | | | / PO | | • • • • | | - | | 1 | 1 | ; | |
| MAINTENC | | | 7 | | | 0 | 2.3 | 2 | • | | | | | | | |
| 51557 | | | ∞ C | 35.34 | 32.66 | : : | | 27.10 | 23.00 | 8 6 | , | į i | | | ŀ | , |
| e c | | • | ? | : | 25.2 | | 5.0 | | ~ | | , | , | , | | | |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 1.3.1-DISHWASHER/PRYER COMBINATION (PAGE 1 OF 2)

| | ACMSER CT SAFETY CALTICAL | 2 | port | 0 | 2 | - | 2 | ~ | m . |
|--------|---|----------------|--|--|---|---|--|---|--|
| | | 0 | | | | | | | |
| | сеидио ггев Пен Евеблей <mark>сх</mark> | 9 | 1 | 1 | 1 | 1 | 1 | - | - |
| | TELECTPOACOUSTIC | (3) | 1 | 1 | ı | 1 | 1 | H | |
| | NAIT THEIGHAL STORAGE | احما | 1 ' | 1 | 1 | ı | pref | ı | • |
| 2 - 7 | CVITIZLER DERICCVNI | (3) | ŧ | 1 | • | | 1 | 1 | 1 |
| ы 2 | IEATER OC | 0 | | 1 | - | | 1 | 1 | - |
| 0 A E | VI B PLONER | (3) | 1 | - | | | 1 | 1 | - |
| 0 ပ | TIMER CONTROLLER | | | | | - | | | |
| и. | EXCHANGER | (3) | ı | - | | | -i | , | ~ -1 |
| 0 | ורדנג. | 9 | - | - | 4 | , | - | | H |
| м ж | (GEVK BOX) LEVKRHIZZION | 0 | | 1 | r-4 | | - | | H |
| ∞ Σ | ANTER ANTER | (9) | | | F-1 | H | ~ | F-1 | |
| N | /ccumulator | (| 2 | 2 | ۷ . | ~ | ~ | 2 | 2 |
| | COLENOID VALVE | (0) | 2 | 2 | ~ | m | 2 | 2 | 2 |
| | dWnc | 0 | | | | - 1 | H | H | н |
| | 4010R | 0 | 2 | , | 2 | 2 | 8 | 7 | 2 |
| | CCMPONENT TYPE | APPLIANCE TYPE | HOT WATER SPRAY WASHING, CENTRIFUGE DRYING (pg. 98) | HOT WATER SPRAY WASHING, AIR SPRAY DRYING (pg. 100) | HOT WATER SPRAY WASHING FORCED HOT AIR ELECTRIC HEAT DRYING (pg. 102) | HOT WATER SPRAY WASHING, FORCED COLD AIR-DESICCANT, ELECTRIC DESORSED (pg. 104) | HOT MATER SPRAY WASHING, FORCED HOT AIR DRYING USING THERMAL STORAGE (pg. 107) | ULTRASOVIC WASHING, CENTRIFUGE DRYING (pg. 109) | ULTRASONIC WASHING, FORCED HOT AIR F.ECTRIC DRYING (pg. 111) |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APFLIANCE FUNCTION: 1.3.1-DIS:MASHER/DRYER COMBINATION (CONCLUDED) (PAGE 2 OF

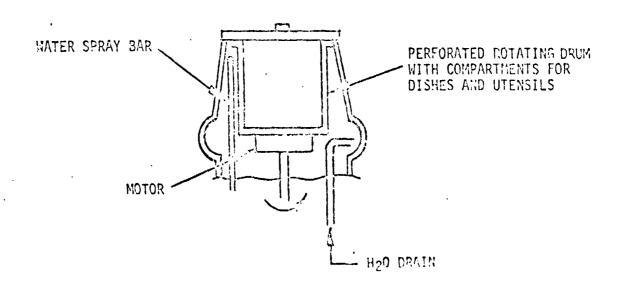
CRITICAL NUTSER SAFETY 7.E.1 b соитвог, Е**в** Итси Евебл<mark>енск</mark> CLFCTROACOUSTIC STHERMAL STORAGE S CANISTER DESICCANT z DC DC ш z O VIB BLOWER CONTROLLER LIMER C ပ WEAT XCHANGER LL_ 0 FILTER (GEVK BOX) LEVACHIZZION Ų ы NATER SEPARATOR ന ACCUMULATOR (a) S --1 COLENOID VALVE ~ ~ **d**Wnd яоток(С ~ MANUAL WASH-MANUAL WIPE (pg. 119) COMPONENT TYPE ULTRASCHIC WASHING, FORCED HOT AIR DRYING USING THERMAL STORAGE (pg. 117) ULTRASONIC WASHING, F DRY AIR-DESICCANT, DESOREED (pg. 115) RPPLIANCE TYPE

DARWAY !

| SPACECUART Space Station | |
|--|---|
| HABITABILITY SUBSYSTEM Food Majoggreat HABITABILITY FUNCTION Cleanup | _ |
| APPLIANCE FUNCTION Dishwasher/Dryer Combination | _ |
| APPLIANCE CONCEPT NO./TITLE 1/Hot Mater Spray Wash-Centrifuge Dry | |
| INDEX NO. 1.3.1.1 REF. NO. 90 | _ |
| | |

DESCRIPTION

In this concept, washing is accomplished by spraying hot water (with an 8 psig pump head) over the dishes in a slowly rotating drum. Drying is assumed to be accomplished simply by centrifugal force at high speed rotation. This concept is included in the trades since conceptual data are available; however, the drying method is unproven and doubtful.



ORIGINAL PAGE E

D2·118561:4

| (Ref. #90 +98 | 3 ,9 9) | · | • | | | | |
|---------------------------|---------------------------|----------------------|------------------------|--|----------------------------|--------------------|---|
| (Netion 1 7) | ELECI | RICAL ! | POWER | <u>R E Q U 1 R E</u> | <u>M E N T S</u> | | |
| | • | A (| C . POWE | | D | C POWE | |
| COMPONENT (REF) | USE TIME CYCLE (HR) | ② PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WATTS) | (7) DEMAN (WATT-H CYCLE) ① X (7 |
| Motor · · | | 150 | | | <u></u> | | |
| Pump | | | | | 20 | | , |
| | | • | | | | · | |
| | | | | | | | |
| . • | • | .150 . | | TOTAL | 75 MAXIMUM | | TOTAL |
| `, | | • | • | | | | • |
| | | | • | | • | | |
| | • | HERMAL | P F O H T I | REMENIS | | • | |
| • | 2 | .UEBCAE | SEX DI | | | | |
| SOURCE | | LATENT (BTU/HR) | | SIBLE U/HR) | HEAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| Vater heat loss (Pump | 40°F) _ | 0 . | | 00 } | 12 <i>00</i> | -} ₁ | 0 |
| Motor | • | 0 | ~ | 12 | 512 | | 0 |
| Vator (dry) | | 318 | -3, | 18 | o | - - | 0 |
| , | TOTAL | 93 (318) | 372 | (1268) | 372 (126 | ·8) | 0 |
| | ١ | MATT (BTU/HR) | WATT_(| (BTU/HR) | WATT (BTU/HR |) WAT' | T (BTU/HR |
| | | • | | | | | • · |
| • • | | . · | • | | : | | • |
| • | | <u> ERAIlo</u> n | LAL PE | HALILES | | · | |
| SOURCE . | HEAT (BTU/HR/C | | COOLANT I/HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | WEIGH LE) (LB/MISS • | | AOT THE |
| N/A | | | ••• | | | | • |
| | | | | | | | |
| | | ********** | | | | | |
| . 10 | TAL MATTS, | 'CYCLE NA | TTS/CYCLE | dage 60 day represents to | KG/H1SS | ION N ³ | MISSION |

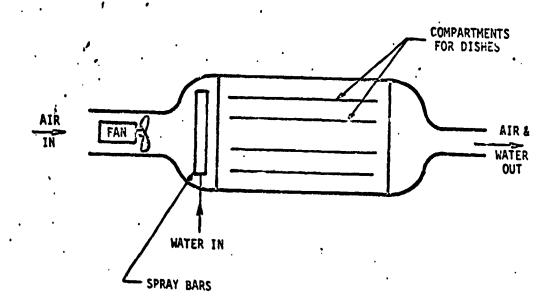
| concept Hof water spray - centri | strements and penalties calculfuge drying | | WER 1, 3.1.1 |
|---|--|--|--|
| COMPONENT (REF) | HI/YOLUME REQU WEIGHT (LBS) 40 | I R E M E N T S | VOLUME (FT ³) |
| Punj. 2 Accumulators Valvina | 11. | | |
| Water : parator Packagina Dishes/atinsals/sups Total | $\begin{array}{r} 3 \\ 32 \\ 15.2 \end{array}$ | | 0.91 24.5 |
| TOTAL | 1 50 1 (111) | | |
| | 50.3 (111) KG (LBS) | | 16 (25.3) N ³ (FT ³) · |
| TYPE UNITS/CYCLE(REF) (PKG.W | ABLE MT/VOL RE (D) (D) (AB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) | VOL/UNIT (REF) (PKG. VOL/UNIT) (REF) (PKG. VOL/UNIT) (RE (FT3) | VOL/CYCLE F) |
| TOTAL MT. | Σ3 <u>ζίς</u> γοται ωτ/σγειι (LB) | | · (FT) |
| MISSION 3 X 184 CYCLES/DAY X DAYS/MISSI TOTAL VOL MISSION 3 X 184 CYCLES/DAY X DAYS/MISSI | (LB) x .000.52 | 0.008 | $\frac{4.5}{66.(16)}$ (9.9) |
| | (FT ³) <u>(Pendables</u> req | <u> </u> | • |
| TYPE ANT. USED/CYCLE (REF Wash water 15 | RECOVERY FACTOR 9991 | WT . RECOVERED/CYCLE O x Ø (LB) | MT LOST/CYCLE 0-3 (LB) 0135 |
| Rinse water 15 | 1.000 | | 0 |
| Σ Φ 30 | | ΣΦ | .0135 |
| TOTAL MT. 3 184 X DAYS/MISSION X | . 0135 YOTAL LOST/CYCLE - 7.45 | 5 · 30 · | 17.0 (37.5) |

| SPACECRAF' | T Space Station | ~ | - | | |
|------------|----------------------|--------------|--------------|-----------|---------|
| HABITABIL | ITY SUBSYSTEM Food M | anagement | HABITABILITY | FUNCTION | Cleanup |
| APPLIANCE | FUNCTION Dishwash | er/Dryer Con | bination | | |
| APPLIANCE | CONCEPT NO./TITLE_ | 2/Hot Wat | er Spray-Air | Spray Dry | |
| INDEX NO. | 1.3.1.2 | | _REF. NO. | 90 | |

DESCRIPTION

I

The washing function for this concept is identical to that used in Concept 1. Drying is accomplished by a high-velocity air spray (30 fps) sufficient to drive the water droplets off the dishes. Thus, the drying air is not heated.



| (Ref# 90 p | 100,101) | • | | <u> </u> | MENIS | | |
|--------------------------------|--------------------|----------------------------|------------------------|-----------------------------|-----------------------------|---------|------------------------------|
| | USE YIME CYCLE | PEAK | 3 AVERAGE | (4) DEMAND (WATT-HR/ CYCLE) | <u>D C</u> S PEAK | POWE | R (7) DEMAND (MATT-HR CYCLE) |
| Valves Fan Tump | (HR) 0 • | (MATTS) | (NATTS) | ①x③ | (WATTS) -55 | (WATTS) | ①x① |
| 7.807 | | | | <u> </u> | | | |
| | | 1350. | . | · ——— | 75 | • | |
| | | MAXIMUM | • | TOTAL | MAXIMUM | | . TOTAL |
| | | IHERMAL. | REQUIR | <u>Emenis</u> | | | |
| SOURCE | | LATENȚ (BTU/HR) | SENSI (BTU/ | _ | HEAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| Water heat loss Pump Fan | <u>(40°</u> F) | 0 . | 12. 461 | 6.8 | _12.00 68 4612 | -, - | 0 |
| Water (dry) | | 318 | <u>C3</u> | | 0 | | 0 |
| ` | TOTAL | 93.2(314) WATT (BTU/HR) | 1351 (B | (4612) J | 1351 (4612 WATT (BTU/HR) | - | O (BTU/HR) |
| • | | | • | | - | • | • |
| | | QPERAILON. | AL PER | Lautes | • | • | |
| SOURCE. | ME/ (BT(*/H | AT LEAK TO | COOLANT HR/CYCLE) | ELECTRICAL (PK WATTS/CY | MEIGHT CLE) (LB/MISSIC | | OLUME (MISSION) |
| | | | | | | | |
| | | | | | | | |
| 1 | TATOTAL WAT | TS/CYCLE WAT | TS/CYL_E /HR/CYCLE) | ******** | KG/115510 (LB/H15510 | M) (ET) | MISSION) |

C2-82

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED) conceptifict water spray - Air spray dry INDEX NUMBER 1. 7. WEIGHT/YOLUME REQUIREMENTS WEIGHT (LBS) VOLUME (FT3) COMPONENT 20 30 0.81 TOTAL (104 0.773 27.3 KG (LBS) M3 (F73) . SQLID EXPENDABLE MINOF REQUIREMENTS OX (C) WT/UNIT (REF)
(PKG.WT/UNIT)(REF) VOL/UNIT (REF) (PKG.VOL/UNIT)(REF) UNITS/CYCLE(REF) (LB) 00052 Germicide $\overline{\Sigma}$ ${f S}$ 184 DAYS/HISSION E & S/L I Q U I D ANT . RECOVEREU/CYCLE RECOVERY AMT.USED/CYCLE(REF)
, (LB) FACTOR 9991 Σ $\Sigma \odot$ -30 0135 17.0 (37.5) (LB) # O

D2-118561-4

| SPACECRAFT Space Station Food | |
|--|--|
| | HABITABILITY FUNCTION Galley Cleanup |
| APPLIANCE FUNCTION Dishwasher/Dryer Co | |
| APPLIANCE CONCEPT NO./TITLE 3/Hot Water | er Spray Wash-Forced Hot Air Electric Heat Dry |
| INDEX NO. 1.3.1.3 | REF. NO90 |
| DESCRIPTION | |
| The washing function for this concept is Washing is accomplished by spraying hot the dishes in a slowly rotating drum. flow of air over the dishes which is he The heater also heats the dishes by rad 1 hour drying time. | water (with an 8 psig pump nead) over Drying is accomplished by a circulating ated by an electrical heating element. |

| | | <u> </u> | C . POWE | R | MENIS D | PONE | |
|--|---------------------|---|-------------------------|-------------------------------------|---|-----------------|--|
| COMPONENT (REF) Volving Fan Motor | USE YIME CYCLE (HR) | PEAR (MATTS) 17 150 | AVERAGE (WATTS) | DEMAND (MATT-HR/ CYCLE) (D x 3) | PEAK (MATTS) 55 | AVERAGE (WATTS) | DENAME (T) |
| Heater Pump | | | | | 271 | | |
| • | | 167 MAXIMUM | • | T01/4 | 226 MAXIMUM | • | TOTAL |
| source lump Vater heat loss Fan Motor Heater Water (dry) | (40°F) | LATENT (BTU/HR) O O O O 318 93.2 (315) MATT (BTU/HR) | | J/HR) 68 00 58 22 33 | HEAT LEAK (BTU/HR) 68 1200 9 522 140 372(1269 MATT (BTU/HR) | | COOLANT TU/HR) O O P O O C O C O C O C O C O C O C O C |
| • | | Q <u>P E R A T I Q</u> THERMAL AT LEAK | ' | M A L I L E E El Ectrical | WEIGHT | · | DLUME |
| source | (BTU/H | M/CYCLE) (B | TO COOLANT TU/HR/CYCLE) | (PK WATTS/CYC | | | /M15\$10N) |

| heat dry | (Ref # 90 p 102 | , | | |
|---------------------------------------|-----------------------|--------------------------------------|-------------------------------|-------------------------------------|
| | EIXED MEIG | HIVOLUME REQU | <u>LIREMENTS</u> | |
| COMPONENT | (REF) | WEIGHT (LBS) | | VOLUME (FT³) |
| Basic macher | /drycr | 125, | | |
| Pury | | | | |
| 2 decumulates | | | | |
| Majer serara | 1,7 | 3 | | |
| Fan | | 5 . | | , |
| Part rains | | 43 | | |
| | 11. 151145 | 15.2 | | 24.6 |
| 70121 | | | | 2000 |
| | | | | |
| INAL PAGE IS | TOTAL | 59.9 (13.2 |) / | 1.5 (25. |
| NAL PAGE | • . | KG (LBS) | | M ₃ (LL ₃) . |
| NOOK WO | | •• | • | • |
| 1 | OFID EXSENDY | | EQUIREMENTS | ć |
| | O WI/UN | (REF) WI/CYCLE | VOL/UNIT (REF) | VOL/CYÇLE |
| TYPE , U | V (FRG. 81) | (LB) | (PKG. VOL/UNIT) (REF (FT3) | $\Phi_{x,0}$ |
| Determent _ | -1 $-\frac{2}{6}$ | 15 018 | 00044 | .0005 |
| Borniside | <u>لامال</u> | <u> </u> | (.00052) | - |
| · · · · · · · · · · · · · · · · · · · | | · | | - |
| | ********* | | | |
| | | | | • |
| | | | | - |
| · | | $\Sigma \mathfrak{D}$ | Σ | TOTAL VOLTEY |
| • | | Σ ^③ Yotal Vit/eve (LB) | u | TOTAL VOL/CY |
| TOTAL NT. 3 | x _ 184 | x .019 | | 4.5 (4.9) |
| CYCLES/ | | N YOY.WYZCYCLE | | RE (LD) |
| TOTAL VOI | | (LB) | | |
| TOTAL VOL | DAY X BAYS/HISSTS | x | 0.00 | 055 (0.3 |
| U CIGEES/ | oni pris/nissi | (FT ³) | | (۱۹) دا |
| | • | • | • | • |
| · • ! | EASVIGNID EX | PENDARLES RE | RULREMENTS | |
| • | . • | ② | ANT . RECOVERED/CYCLE | MIT LOST/CYC |
| | . MIT.USED/CYCLE(REF) | RECOVERY | MT.RECOVERED/CYCLE | ANT LOST/CYCI Q-Q (LB) |
| Wash water | · (i.e) | FACTOR | (10) | (18) |
| Rinse water | <u> </u> | 1.000 | | .0135 |
| 17111 | | | | |
| | | | | |
| | | - | | |
| | | | | ^ 4 6 |
| | 30 | | Σ • | .013 |

72-118561-4

| SPACECRAFT Space Station | | | | • | | | | | | |
|--|-------------|--------|---------|---------|------|------|------------|-------|--|--|
| Food | ement (| HABIT/ | NBILIT' | Y FUNCT | 10N_ | Gall | ley Cleanu | ıp_ | | |
| ABITABILITY SUBSYSTEM Management HABITABILITY FUNCTION Galley Cleanup PPLIANCE FUNCTION Dishwasher/Dryer Combination PPLIANCE CONCEPT NO./TITLE 4/Hot Water Spray Wash-Forced Cold Air Desiccant Dry | | | | | | | | | | |
| APPLIANCE CONCEPT NO./TITLE_ | 4/Hot Water | Spray | Wash- | Forced | Cold | Air | Desiccant | : Dry | | |
| INDEX NO1.3.1.4 | | REF. | NO | 90 | | | | | | |
| | | | | | | 1 | | | | |

DESCRIPTION

In this concept, washing is accomplished by spraying hot water over the dishes in a slowly rotating drum. A fan is used during washing and rinsing to transport air and excess water out of the washer. The same fan is used to circulate air through the dishes for drying. The air is routed through a desiccant bed upstream of the dryer to dry the air first; thus, no additional heat is assumed necessary. The desiccant is desorbed using an electrical resistance heater sized for a 1 hour desorption time.

| | | RICAL | <u>POMER</u> C. POWE | R | MENIS De | C POWE | R |
|---|-----------------------------|---|-------------------------|--|--|-----------------|---------------------------------|
| MPONENT (REF) Mc400- Casa | USE YIME CYCLE (MR) 1 3 | ② PEAK (MATTS) 150 21 | AVERAGE (WATTS) | DEMAND (WATT-MR/ CYCLE) (DX 3) | PEAK (WATTS) | AVERAGE (HATTS) | DEMA (HATT- LYCLE (DX) |
| alves ump leater | | | | | 55 17 90 | | |
| | | 17/1. | | TOTAL | 145 Maximum | | TOTA |
| · | . • | • | • | | | | • |
| | 1 | EHERMAL | REQUI | EMERIS. | | | • |
| SOURCE | | LATENT (BTU/HR) | • | IBLE I/MR) | NEAT LEAK (STU/HR) | | COOLANT TU/HR) |
| later heat loss Jump Motor an Yeater Vater (dry) | TOTAL | 0 0 0 0 0 3/8 93.2(314) | _5 _3(-3/ 369 | 00 58 12 82 07 8 (1259) BTU/HR) | 12.00 58 5.12 12 46 369 (125 WATT (BTU/HR) | يو اري | O O (70) ≥61) (33) |
| • | • | | • | • | 8 0. | • | |
| | | | | Mallier | | | • |
| | . 2 | PERAILS! | TAF SE | 4-3-1 | | • | |
| SOUNCE | • | THE THE THE | COOLANT | ELECTRICAL (PK WATTS/CYC | WEIGH LE) (LB/MISSI | | OLUME /MISSIO |
| sounce N/A | , NEAT | THE THE THE |) COOLANT | ELECTRICAL | | | |

WATTS/CYCLE (BTU/HR/CYCLE) LG/MISSION (LB/MISSION) M³/MISSION)

WATTS/CYCLE (BTW/WW/CYCLE)

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS. (CONCLUDED) CONCEPT // wider spray wash - forced roll air desiccant INDEX NUMBER 1. ... 1.4 FIXED MEI.CHI/YOLUME <u>REQUIREMENTS</u> WEIGHT (LBS) VOLUME (FT3) COMPONENT (REF) 12.0 Ecn T 34 Packarin INAL PAGE IS
POOR QUALITY (124) TOTAL KG (LBS) M3 (FT3) -EXPENDABLE SOLID MINDF REQUIREMENTS MI/CYCLE WT/UNIT (REF) VOL/UNIT (REF) (PKG.WT/UNIT)(REF) (PKG.VOL/UNIT)(REF) (FT3) UNITS/CYCLE(REF) TYPE 00044 Defersent Servisida TOYAL VOL/CYCLE (FT) TOTAL WITCYCLE (LB) 184 DAYS/MISSION O18 TOT. VIT/GYCLE CYCLES/DAY (LB) TOTAL VOL 124 00052 DAYS/MISSION GAS/LIQUID EXPENDABLES . ② AMT . RECOVERED/CYCLE 0 RECOVERY AMT. USED/CYCLE (REF) **FACTOR** · (LB) Wash 9941 $\Sigma 0$ Σ 30 .0135 DAYS/HISSION (LB) # O

| SPACECRAF' | T Space St | ation | | | • | | | | |
|------------|-------------|----------|-------------|----------------|----------|---------|--------|-----------|-------------------|
| | ITY SUBSYST | Food | gement | — _HABITABI | ILITY FU | NCTION. | Galley | Cleanup | _ |
| APPLIANCE | FUNCTION | Dishwa | sher/Dryer | Combinati | on , | | | | |
| APPLIANCE | CONCEPT NO | ./TITLE_ | 5/Hot Wate | r Spray W | ash-For | ced Hot | Air Dr | y-Thermal | _ Stora ge |
| INDEX NO. | 1.3.1. | 5 | | REF. NO |)9 |) | | | - , |

DESCRIPTION

In this concept, washing is accomplished by spraying hot water (with an 8 psig pump head) over the dishes in a slowly rotating drum. Drying is accomplished by circulating a flow of air over the dishes. Washer water is routed through a thermal storage unit which stores heat to be used during the drying cycle to heat the inlet air.

| | 1:12/ wa | ch - fo | requirements and | PENALTIES CALC | CULATIONS INDEX | NUMBER 1. 1 , 1 , 47 |
|---------------------|---------------------------|---------------------------------|-------------------------------------|--|--|-----------------------------|
| thermal sto | | R1CAL | .p 107, 108) POWER | REQUIRE | MENTS | |
| | | | AC . POWI | • | D (| |
| . COMPONENT (REF) | USE TIME CYCLE (HR) | ② PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (WATTS) | (7) |
| Yalyec . | 0. | | | | <u></u> | |
| Motor Pump | | 150 | | | 17 | |
| Fan | | 76 | | ~~~~ | ·········· | |
| | | · | | | | |
| * | | | | | | |
| | | 400.4 | | | ~ ~ | • |
| • | | 18.6_ MAXIMUM | -• • | TOTAL | 72 HAXIMUM | TOTAL |
| ·•. | | • | | | | • |
| | . • | | | | , | • |
| • | | | | • | | |
| | | LHERMA | L REQUI | REMENIS | | • |
| SOURCE | | LATENT (BTU/HR) | | ISIBLE TU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
| Pump | - | 0 | • | 58 | 58 | |
| Motor | | 0 | | 12) | 512 |) |
| Fan | | 0 | | $\frac{3}{2}$ | 122 | $-\frac{0}{1342}$ |
| Water / thermal sto | rage . | 318 | | () | 236 | 1372 |
| , | , | · - / | | (0 -) | |) |
| | - | 13.2 (3 <u>1</u> Watt (btu/h | | (1895) J (BTU/HR) | 255 (87 WATT (BTU/HP) | |
| | | • | , , | | ************************************** | WATT (BTU/HR) |
| • | • | | | · · | , | |
| , , | • | | • | | 14 . | • |
| • • | | | | | • | • |
| • | ₹ . | PERALI | • | EMALILES | | • |
| SOURCE. | HEAT (BTU/HR/ | THERM LEAK CYCLE) | IAL TO COOLANT (BTU/HR/CYCLE) | ELECTRICAL (PK WATTS/CY | CLE) (LB/MISSI | |
| N/A | | | ٠, | | . · · | · · |
| | | | | | | |
| • | | | | | | • |
| } | | , | | · | | , |
| | ···· | | | * | | |
| . 10 | WATTS | /CYCLE R/CYCLE) | WATTS/CYCLE (BTU/HR/CYCLE) | • | KG/MISSI (LD/MISSI | ON H3/HISSION (FT3/MISSION) |

| CONCEPT <u>//cf wode</u> | | | | | | .CULATION | S (CONCLUDED) | NUMBER 1. 3. | 1.5 |
|----------------------------|-------------------|---------------------|--------------------|------------------|--------------------------------|-------------|--------------------------|-----------------------|--|
| thermal | storage | | | | , | ' | | | |
| | <u>F 1 X </u> | ED WE | . I G H I/Y | | | Q U I R E | MENIS | | |
| COMPONENT | / 1 | (REF) | | | WEIGHT (LBS) | | | VOLUME (FT3) | |
| <u>Basic nasho</u> Punn | r/dryer | | | | <u>40</u> | | | | |
| | 115 | | | | 11 | | | | |
| Valzing | | | | | <u>_6</u> | | | | · |
| Fan | 2-21 | | | | 3 | | | | , |
| Thermal day | aze wit | | | | 3.7 | | | | |
| Pactures Disha / Tetins | els/curs | | | | <u>51</u> 15.2 | | | 0.81 | |
| Te La! | | | | | | | | 2,6,0 | |
| • | | TOTAL | ا | | - /4. | ~ | <u> </u> | 15 5/ | • |
| | · | TUIAL | . Ļ., | | 76 (167) G (LBS) | 7) | L | 12.2(2 N3 (FT3) | 6.8) |
| | | | .• | * | G (LD3) | | | , Me (F1-) | • |
| . • | <u> 5 0 L 1 D</u> | EXPE | NDABL | | | REQU | | • | <i>'</i> |
| | Φ | 1 | WT/UNIT (R | EF) | ALL ACTOR | .ε | VOL/UNIT (REF |) VOL/C | AČľE D |
| TYPE | UNITS/CYCLI | E(REF) | KG.WT/UNIT (LB) | | ①x② | | (PKG.VOL/UNIT)((FT³) | | : |
| Detergent/ | 1_ | | 015 | | .018 | | 1.00052 | | 252 |
| Gernieide | | | | | | | | | |
| | | | | == | | | | | |
| | | | | , | | | | | · |
| | | | | | | | | | |
| | • | | | Σ3 | TOTAL WI/C | YCLE | · Σ | TOTAL VO | CYCLE |
| OTAL WT | 7. | . 10 | 4 | | . 019 | | | · | 9.9) |
| CYCI | LES/DAY | | MISSION | _ ^ | TOT. HT/CYCLE (LB) | | | KG (LB) | 1-7) . |
| MISSION CYCL | CES/DA/ | | 8.4 Mission | _ × | 00052 101.VOL/CYCL (FT3) | <u>.</u> | 0. | 0085 ((| 0.3) |
| | • | | • | , | | | | | |
| | <u>e a s/l 1</u> | QUID | EXPE | N D A B | LES R | EQU1 | REMENTS | | |
| | • | Φ | | | ② | | ECOVERED/CYCLE | |) |
| - Punc | . AM 1 | .USED/CYCLI | E(REF) | - | COVERY | AMT.R | ECOVERED/CYCLE (LB) | AMT LOSŤ O-(LB | ACACTE |
| Wach moder | •``. | 15 | | | ACTOR 1991 | | (LB) | 013 | 5 |
| River water | | 15 | • | 1.0 | 200 · | - | | | - |
| | | . | | | | | | | |
| | | | • | | | | | | |
| · | — <u> </u> | | | | | · | | | - F- |
| • | Σ_0 – | 30 | | | • | | Σ |)01 | 35 |
| OTAL NT. 3 | | 184 | | 012 F | 2 | Цe | . 30 | - 17.0 (| 37.5) |
| MISSION CYCLE | 7DAY X1 | XY S 7H15ST0 | X TOT | 0135 L LOSI/C | VCLE | 12. | <u> </u> | KG (I | |

| SPACECRAFT Space Station | |
|--|--------------------------------------|
| Food HABITABILITY SUBSYSTEM Management | HABITABILITY FUNCTION Galley Cleanup |
| | |
| | |
| APPLIANCE CONCEPT NO./TITLE 6/Ultrason | ic Wash-Centrifuge Dry |
| INDEX NO. 1.3.1.6 | REF. NO90 |
| | |

DESCRIPTION

This concept is identical to Concept 1 except that ultrasonic cleaning is used to clean the dishes instead of a high velocity water spray. No ultrasonic energy damping is assumed. Drying is assumed to be accomplished by centrifugal force at high speed rotation. The concept is included in the trades since conceptual data are available; however, the drying method is unproven and doubtful.

| (Kef. #90) | . 109, 116) | | , , | | | | |
|--|---------------------------|--|-------------------------|-------------------------------|---------------------------|--|--|
| | £ L E C | • | <u> </u> | REQUIRE R | MENIS DC | POWE | P |
| COMPONENT (REF) | USE TIME CYCLE (HR) | | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (NATTS) | 6 AVERAGE (WATTS) | DEMAND (WATT-HR) CYCLE) (DX() |
| Velves Jump Alder HF gumanter | | 150 2.50 | | | | | |
| | | 250 | | | 72 | | |
| ORIGINAL PAGE IS OF POOR QUALITY | , . | MAXIMUM | • | TOTAL | MAXIMUM | , | , TOTAL |
| | | IHERMAL. | | REMENIS | | , | |
| SOURCE | | LATENT (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| Water heat loss | (4c°F) | 0 . | _12 | 00 | 12.00 58 | -} | 0 |
| HF generator Motor | · | | 85 51 | 2 | <u>853</u> 512 | _ | 0 |
| Water (dry) | TOTAL | 318 93.2 (3)8) WATT (BTU/HR) | NATT (| BTU/HR) | 619 (211 WATT (BTU/HR) | 1) — — — — — — — — — — — — — — — — — — — | O T (BTU/HR) |
| | | • | | : | • | | |
| * * | | <u>QPERATION</u> | AL PE | NALILES | | | • |
| / SOURCE | | THERMAL AT LEAK TO R/CYCLE) (BTU | COOLANT /HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | WEIGHT | | 3/HISSIUH) 4 O FME |
| N/A | | • | • . | | | | |
| <u>'</u> | | | | | | | |
| • | TOTAL WAT | TS/CYCLE WAT | TS/CYCLE I/HR/CYCLE) | | KG/H15510 (LB/H15510 | M M' | MISSION |

C2-94

| | EIXE | n mrich | | EQUIREM: | <u> </u> | |
|----------------------------|--------------|-----------------------|--------------------|------------------------------|---------------------------------------|-------------------------------------|
| COMPONENT | | (REF) | WEIGHT (LBS) | | • | VOLUME (FT ³) |
| Back of | hildry. | | 50 | | *** | |
| Yan j | | | <u> </u> | | | |
| Z Acres | 104015 | | 11 | | | |
| | 3, 34,1 | | ? | | | |
| Controll r | | | 57 | <u> </u> | | |
| 10, 0001; | | - | 40 | | • | 45 (1.4 |
| Total | 4 | | 15.2 | | . 1 | 0.81 |
| 10481 | | | | | | <u> </u> |
| <u> </u> | | | | | · | |
| TAGE IS | • | TOTAL | | 2,4) | 0.74 | 5 (2 |
| VAL PROLITY | | | KG (LBS) | | 1 | M ₃ (ŁI ₃) . |
| NAL PAGE TO DOR QUALITY | <u> </u> | EXPENDAL | B <u>le MT/YOL</u> | REQUIR | EMENTS | |
| | 22222 | • | (D) (REF) MT/C | | OL/UNIT (REF) | VOL/C |
| | 0 | (PKG. WT/I | UNIT)(REF) (3)X | YCLE VI | OL/UNIT (REF) G. VOL/UNIT)(REF) (FT3) | VOL/C ①X (FT |
| Deserger / | UNITS/CYCLE | | LB) (L | | (FT3) 000414: | (FT) .000 |
| <u> </u> | | | | <u> </u> | (1222) | |
| <u>Gormicido</u> | · | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | • | Σ3 TOTAL N | / <u>(/</u> T/CYCLE B) | · \(\sum_{\infty}\) | TOYAL VOI |
| TOTAL NT. | , | | | | | |
| MISSION | CYCLES/DAY X | DAYS/MISSION | X | , • 13 | 4. | 5 (9. |
| | CICEES/DAI | G (13)/1133101 | (LB) | | • | W (CD) |
| TOTAL VOL | 3 x | 184 | x .000 | 25 • | 0.00 | 8.5 0 |
| | CYCLES/DAY | DAYS/MISSION | x | YCLE | | Ma (kaa) |
| | | • | | | • | |
| • | | \ | PENDABLES | REQUIRE | MENIS | _ |
| ` | <u> </u> | _ | . 2 | | | Œ |
| | ANT | USED/CYCLE (REF) | RECOVERY | ANT . RECO | AEBED/CACFE | AMT LOST |
| TYPE | ** | · (LB) | FACTOR | | XØ (LB) | Ø-(|
| Wach water | | <u>• 15</u> | | | | .013 |
| Rines wat | <u>er</u> | | 1.000 | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| SPACECRAFT Space Station | • |
|--------------------------------------|---|
| Food HABITABILITY SUBSYSTEM Manag | ement HABITABILITY FUNCTION Galley Cleanup |
| APPLIANCE FUNCTION Dishwashe | |
| | |
| APPLIANCE CONCEPT NO./TITLE_ | 7/Ultrasonic Wash-Forced Hot Air Electric Dry |
| INDEX NO1.3.1.7 | REF. NO. 90 |
| | |

DESCRIPTION

Ultrasonic cleaning is used to clean the dishes, with no ultrasonic energy assumed lost due to damping. Drying is accomplished by a circulating flow of air over the dishes which is heated by an electrical heating element. The heater also heats the dishes by radiation. Heater size is based on 1 hour drying time.

| | | A C | <u>OMER</u> . POWE | | MENTS D | C POWE | |
|------------------------|---------------------|--------------------|-----------------------|---|-----------------------|-----------------|-------------------------------|
| COMPOSENT (REF) | USE TIME CYCLE (HR) | PEAK (WATTS) | AYERAGE (WATTS) | DEMAND (MATT-HR/ CYCLE) ① X ③ | DEAK (WATTS) | AVERAGE (WATTS) | DEMAND (WATT-HR, CYCLE) ① X ⑦ |
| Meter Heater Fan | - 20 | 150 | | | 271 | *********** | , |
| HF over other Pump | | 250 | | | 20 | | |
| | | | | | | | |
| | | 250. | • | | 326 | • | |
| IGNAL PAGE IS | | HAKIHUM | • | TOTAL | MAXIMUM | | , TOTAL |
| POOR QUALITY | · • | | • | | | | • |
| | | THERMAL | REQUI | REMENIS | | | |
| SOURCE | | LATENT (BTU/HR) | | SIBLE U/HR) | HEAT LEAK (BTU/HR) | - | COOLANT BTU/HR) |
| Water had lose | (10°F) | 0. | | 00 | 1200 | -) — | <u>.</u> |
| HE generaly | | | | <u>68.</u> 53. | <u>853</u> | | 0 |
| Motor Heater Lean/war | ler | 318 | | 7.3 | <u>512</u> 149 | - | <u>0</u> 842 |
| | TOTAL | 93.2(318) | | · | 621 (212 | 21) 24 | 7(342) |
| • | | • • | MAII (| (BTU/HR) | WATT (BTU/HR) | · WATT | (BTU/HR) |
| • | | • | | | - | • | , |
| ** | • | | | | ·. | | • |
| ••• | , | QPERATION. THERMAL | AL ZE | HALIIES | • | ٠ . | |
| SOUPCE | | IT LEAK TO | COOLANT HR/CYCLE) | ELECTRICAL (PK WATTS/CY | | | MISSION) - |
| | | · | | *************************************** | | | |
| | | | | | | | |

C2-97

| | FIXE | D WEIGH | TAOFAWE | REQUIP! | MENIS | |
|------------------------------------|--------------|---|--------------------------------|-----------------------|--|------------------------------|
| COMPONENT | ,, | (REF) | WEIG (LE | 35) | | VOLUME (FT ³) |
| Turn | 1 /dry r | - | 5 | <u> </u> | <u></u> | |
| Z Accumula | 1, 1 | - | 1 | 1 | | |
| | ,1,, | · | | <u>7</u> | | |
| Controller | | , - | | <u>5</u> | | |
| Ticker uting | . / . / | | . /, | 57 . 52 | | 0.21 |
| T.1.1. | | | | | | 20.0 |
| RIGINAL PAGE IS OF POOR QUALITY | 1 | TOTAL [| | 7 (147) | 0.7 | |
| RIGINAL QUALITY | | | KG (L | .BS) | • | N3 (FT3) · , |
|)E | <u> </u> | EXPENDA | FE RIA | | IREMENIS O | , (S) |
| | 0 | WT/UNI'i (PKG.WT/U | NIT)(REF) | O MT/CYCLE Ox O | VOL/UNIT (REF) (PKG.VOL/UNIT)(REF) (FT3) | 00L/CYCI 10X4 10X4 |
| Doto, man | UNITS/CYCLE(| | | -(LB) - <u>ひま</u> | .0001111 | (FT) .0005 |
| <u> </u> | | 1.7.10 | | | (.0000) | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| • | | • | Σ \bigcirc \bigcirc | YAL WYZCYCLE (LB) | · \(\sum_{\infty}\) | TOYAL VOL/(|
| TOTAL NT | -3 x | 194 | | 010 . | 7 | r.5 (9. |
| , CYC | LES/DAY | DAYS/HISSION | Y0?. | WY/CYCLE (LB) | , | KG (LB) |
| MISSION CYC | LES/DAY X | 1 Q 4 DAYS/HISSION | xrof. | OODE? | 0.00 | <u> इट (०</u> |
| | | • | | : | • . | • |
| · · . | E V ZVF T O | | BIBADER | | REMENIS | • |
| | , AHT. | USED/CYCLE(REF) , (LB) | RECOVE | .KI | ECOVERED/CYCLE Ox (LB) | AMT LOST/CT |
| Wash water | | • (LB) • 15 | FACTO 929 | | (LB) | .0125 |
| Rinso wate | ` * | <u> 15 · </u> | 1.000 | , | | 0 |
| | | | | | · | |
| | | | | | | |

D?:118561-4

| SPACECRAFT Space Station · | |
|---|-----|
| Food HABITABILITY SUBSYSTEM Management HABITABILITY FUNCTION Galley Cleans | ıp_ |
| APPLIANCE FUNCTION Dishwasher/Dryer Combination . | |
| APPLIANCE CONCEPT NO./TITLE 8/Ultrasonic Wash-Forced Cold Dry Air-Desiccant | |
| INDEX NO. 1.3.1.8 REF. NO. 90 | :d |

DESCRIPTION

(I)

Ultrasonic cleaning is used to clean the dishes, with no ultrasonic energy assumed lost due to damping. Drying is accomplished by air circulated first through a desiccant bed where it is dried; thus, no additional heat is assumed necessary. The desiccant is desorbed using an electrical heater sized for a 1 hour desorption time.

D2:118561-4

| , | EFEC | A | POWER | REQUIRE R | <u>M E N I S</u> | C PONE | R |
|-------------------|---------------------------|--|-------------------------|---|-------------------------|-------------------------|--|
| COMPONENT (REF) | USE TIME CYCLE (HR) | PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) (DX(3) | S) PEAK (HATTS) | ⑥ AVERAGE (WATTS) | DEMA (HATT- CYCLE (D) X (|
| Roda, Pains | <u>o·</u> | 150 | | | <u>55</u> | | ······································ |
| Herry | | 250 | | | 90 | | |
| | | • | | • • • | | | · |
| | | 250 . Maximum | • | TOTAL | 145 MAXIMUM | • | . TOTA |
| IGINAL PAGE S | . • | • | ·. · • | | , | · . | • |
| | | IMERMAL | BEONTE | REMERIS | | • | |
| Source | | LATENȚ (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | COOLANT |
| Water heat loss (| | 0. | | 00 11 | 1200 | -} | 0 |
| Meter / fon /w | | O 3/8 | | 71 | 512 58 | | 0 |
| | TOTAL | 93.2 (212) | | | 677 (23) | 1) 97 | 0 (3 |
| • | | WATT (STU/HR) | WATT (| BTU/HR) | MATT (BTU/HR) | WATT | (BTU/HR |
| | | | | : ` | | • | |
| • | | | LAL. PE | Maliies | • | | •• |
| v., | | THERMAL IT LEAK TO R/CYCLE) (BTU | COOLANT J/HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | MEJGHI LE) (LB/MISSI | | Lume Mission |
| SOURCE. | (0.0/.0 | | | | | | |

C2-100

WATTS/CYCLE (BTU/WR/CYCLE) KG/MISSICH (LB/MISSION)

M¹/M;\$\$100 (11³/M1\$\$10M)

TOTAL

WATTS/CYCLE (BTU/HR/CYCLE)

| TYPE UNITS/CYCLE(REF) UNITS/CYCLE(REF) (PRE-NT/UNIT)(REF) (CONT.) (CONT | | " FIXED MELS | HIVOLUME REAL | <u>IIRE SENTS</u> | |
|--|-------------|----------------------------|--|---------------------------------------|------------------------------|
| | COMPONENT | (REF) | MEICHT (LDS) | | VOLUME (FT ³) |
| TOTAL 64.9 (12.1) TOTAL 64.9 (12.1) REG (LES.) REG | Pacie Li | 1.1. 1. | - | | |
| TOTAL G4.9 (12-1) TOTAL G4.9 (12-1) REG (LBS) REG (L | 2 Acres ich | \ <u></u> | | | |
| TOTAL G4.9 (12-1) TOTAL G4.9 (12-1) REG (LBS) REG (L | Valsey | | manufacture of the second seco | | |
| TOTAL G4.9 (12-1) TOTAL G4.9 (12-1) REG (LBS) REG (L | T. C. L. | underwas in a transmission | <u> </u> | | |
| TOTAL C4.9 (1/) 13.1 (-/- RE (LBS) M3 (FT3) SOLID EXPENDABLE MI/VOL REQUIREMENTS POOR OFFICE (PRG. NOT/UNIT) (REF) OFFICE (PRG. NOT/UNIT) (REF) OFFICE (PRG. NOT/UNIT) (REF) OFFICE (LB) TYPE | | | | | |
| TOTAL GA.9 (12) RE (LBS) REQUIREMENTS POOR WIT/UNIT (REF) WIT/UNIT (R | | | | | |
| TOTAL C4.9 12.11 | か ・ノー・ | 7. | | | |
| TYPE UNITS/CYCLE (REF) OTAL UT. OT | 7.7.1 | TOTAL | 149/12 | | |
| TOTAL WIT. TOTAL | | | | <u></u> | |
| TOTAL WIT. TOTAL | FAGLER | | | • | |
| TOTAL WIT. TOTAL | NAU QUA | POLID EXPEND | | EQUIREMENTS | • |
| TOTAL WIT. TOTAL | BOOM | () Wi /(| MIT (REF) MT/CYCLE | VOL/UNIT (REF) | / AOT\CACTE |
| TOTAL WIT. TOTAL | TYPE | | (LB) (LB) | (FT3) | (113) |
| TOTAL WIT. TOTAL WIT/CYCLE (LB) TOTAL VOL/CYCLE (LB) TOTAL VOL (TT 1) TOTAL VOL (TT 1) TOTAL VOL (TT 1) TOTAL VOL (TT 1) TOTAL VOL (LB) TOTAL VOL (LB) TOTAL VOL (LB) | 101 - 101 | | .019 | 0000 | .000F |
| TOTAL WIT/CYCLE OTAL WIT. OTAL WIT. OTAL WIT/CYCLE (LB) TOTAL WIT/CYCLE (LD) OTAL WOL OTAL WOL OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL OTAL | :- <u></u> | <u> </u> | · · · · · · · · · · · · · · · · · · · | | |
| TOTAL WIT/CYCLE OTAL WIT. OTAL WIT. OTAL WIT/CYCLE (LB) TOTAL WIT/CYCLE (LD) OTAL WOL OTAL WOL OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL OTAL | · | | | | |
| TOTAL WIT/CYCLE OTAL WIT. OTAL WIT. OTAL WIT/CYCLE (LB) TOTAL WIT/CYCLE (LD) OTAL WOL OTAL WOL OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL OTAL | | | | | · |
| TOTAL WIT/CYCLE OTAL WIT. OTAL WIT. OTAL WIT/CYCLE (LB) TOTAL WIT/CYCLE (LD) OTAL WOL OTAL WOL OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL OTAL | | | | | |
| TOTAL WIT/CYCLE OTAL WIT. OTAL WIT. OTAL WIT/CYCLE (LB) TOTAL WIT/CYCLE (LD) OTAL WOL OTAL WOL OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL ALSO OTAL WOL OTAL | | | Σ 3 | $-\frac{\Sigma \mathfrak{G}}{\Sigma}$ |) |
| CYCLES/DAY N DAYS/HISSTON N TOT. UT/CYCLE (LB) OTAL VOL | • | | TOTAL WY/CYC | | TOTAL VOLVEYO |
| GTAL VOL. ALSO STAL VOL. ALSO STAL VOL. ALSO STAL VOL. ALSO STAL VOL. ALSO STAL VOL. ALSO STAL VOL. ALSO STAL VOL. | NISTON . | 104 | x .018 | • 4 | 5 (9.9) |
| OTAL VOL | CYCLES | SZDAY DAYSZMISS | TON YOY. WITCHCLE | | KG (LB) |
| CYCLES/DAY DAYS/HISSION TOT. VOL./CYCLY (FT') | GTAL VOL | 104 | | • 6 | 0 F 10 0 |
| (117) | CACTE | | TON YOU'VE VOIL | | No (SYV) |
| | , | | (***) | , | |
| | • • • | FVN/TANTA F | | | |
| EASALIGHTE EXTENDABLES REQUIREMENTS | | O | *************************************** | MT . RECOVERED/CYCLE | MAL TOZI CACT |
| AMT. RECOVERED/CYCLE AMT. LOST/CYCLE | , TYPE, | . MI. USED/CICLE (AE | FACTOR | (ib) | |
| TYPE (LB) FACTOR (LB) | | | | • | |
| TYPE (LB) FACTOR (LB) (LB) (LB) (LB) (LB) | KIRSO A MOD | | 1.000 | • | |
| TYPE (LB) FACTOR (LB) | | | | | |
| TYPE (LB) FACTOR (LB) (LB) (LB) (LB) (LB) | | | | | |
| TYPE (LB) FACTOR (LB) (LB) (LB) (LB) (LB) | | | · | | |

D?-118561-4

Ū

| SPACECRAFT Space Station | • |
|--|--|
| Food | START ITS PUBLICATION COllege Closes |
| HABITABILITY SUBSYSTEM Management HAB | TIABILITY FUNCTION Garrey Creanup |
| APPLIANCE FUNCTION Dishwasher/Dryer Combin | nation . |
| APPLIANCE CONCEPT NO./TITLE 9/Ultrasonic Wa | ash-Forced Hot Air Dry-Thermal Storage |
| INDEY NO. 1.3.1.9 RE | F. NO90 |
| DESCRIPTION · | |
| Ultrasonic cleaning is used to clean the disassumed lost due to damping. Drying is account over the dishes. Washer water is routed which stores heat to be used during the dry | omplished by circulating a flow of distribution distribut |

| | | • | <u>OMER</u> | REQUIRE R | MENIS Do | POWE | R |
|-----------------|---------------------------|-----------------------------|-----------------------|--|--------------------------|-------------------|---|
| CMPONENT (REF) | USE YIME CYCLE (HR) | () PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WATTS) | DETIGNE DETIGNE (WATT-HI CYCLE) ① X ② |
| Main | <u>0·</u> | 150 | | | 55 | | |
| Tump | | | | | 17 | | • |
| HF SCHOOLSY | | <u>36</u> 250 | <u> </u> | | _ , | | |
| - | | | | | | | |
| | | | | , | | | |
| | | 250 | • | | 72 | • | |
| | | MAXIMUM | • . | TOTAL | MAXIMUM | • | . TOTAL |
| • | | • | | | | | • |
| | | • | • | , | • | : | • |
| | | IHERMAL' | REQUIE | REMENTS | | • | • |
| SOURCE | | LATENT (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | COOLANT STU/HR) |
| Pump - HF gener | etch | <u>o</u> . | 2 | 10 | 910_ | | 0 |
| Motor | | | 5 | | 512. | -) | 0 |
| -an | | | | 11 | 123 | -{} | <u>0</u> 342 |
| Nation thermal | sterege | 3/8 | _12,0 | <u> </u> | 236 | -) | 172 |
| | | 92 2 (2.2) | | | (00 | 1) 30 | |
| | TOTAL | 93.2(3.18) NATT (BTU/HR) | | (1875) J BTU/HR) | 255 (S7 WATT (BTU/HR) | 1) <u>39</u> | <u>3 (12</u> / (BTU/HR) |
| • | | • | | . • | · | | |
| | | , | | | • | • | |
| · · · · | | | • | • | | | |
| | | OPERATION | AL PE | NALIIES | `. | | |
| • | , | THERMAL | | ELECTRICAL | WE I GHT | • • | OLUNE |
| SOURCE . | | | COOLANT /HR/CYCLE) | (PK WATTS/CYC | | | (MISSION) |
| | <u></u> | | •. | | . • | | |
| N/A | | | | | • | | • |
| N/A | | ' | | | | | |
| | | | | | | | |

C2-103

| | FIXED | MEIGHI | T/YOLUME RE | QUIREMEN | <u>. \$</u> | |
|---------------------------------------|------------------------------------|-----------------------|---------------------------------------|--|--|-----------------------------|
| COMPONENT | (REF | · • | WEIGHT (LBS) | | | VOLUME (FT³) |
| Table wash | F/ Inver | , | FA | | • | (III-) |
| Nu. 1. | | - | 4 | · | | |
| <u>V</u> | 1 | ~ - | 11 | • | | |
| Nate 1 1 12 | | | | | | |
| Ian | | - , - | 5 | | | • |
| There do | · | | 50 | | | |
| Problems ! | | - - | 1.0 | | | 0.91 |
| 2017 / 144 | 15.15 ye p. | . · _ | 12.5 | | | ٠, ١ |
| 70tal | Total | , T | 85.7 (18 | 0) | 114 | 1000 |
| , | • | · . Ļ | KG (LBS) | <u>: /</u> j | | 13 (FT3) · |
| | | .• | , , , , , , , , , , , , , , , , , , , | | • | |
| INAL PAGE IS | <u>sofid</u> <u>E</u> x | | FE MINOF | <u>R E Q U I R E M</u> | ENTS | , |
| POOR QUALITY | • | WT/UNIT (PKG.WT/UN | (REF) WI/CY | LE VOL/UN | ENTS (IT (REF) (JUNIT) (REF) (T3) (7) // | VOL/CYCI |
| TYPE | ① UNITS/CYCLE(REF) | (PKG.WT/UN (LE | (1) X (1) X (1) X (1) | PKG.VOL | ./UNIT)(REF) :T³) | ① X @ (F1 ³) |
| Didning 1 | 1 | <u> </u> | | , 00 | <u> </u> | -0000 |
| - gamicide | | | | | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | • | YOTAL WIT | CYCLE | Σ \odot | TOTAL VOLVO |
| TOTAL WT | _ | | • | | | |
| MISSION CYC | Z ILES/DAY X — 1 | ノダル DAYS/MISSION | xO/R x | . | 4. | 5 (9.9 G (LB) |
| | | • | (LB) | | • | . (20, |
| TOTAL VOL | .3x | 184 | x .0005 | • | 0.008 | 5 (0.7 |
| CYC | LES/ÇAY - I | DAYS/MISSION | x x yor./cyc | ILE | H | 1 (FY3) |
| | • | , | • | • | • | • |
| | EAS/LIQUI | D EXP | ENDABLES ! | REQUIREME | <u>n t s</u> | |
| ••• | | Φ | ② | | | AMT LOST/CY |
| | . MT.USED | CYCLE (REF) | RECOVERY | AMT . RECOVERED AMT . RECOVERED (LB) | CYCLE | O -3 |
| Wash water | • (| (LB) <i>15</i> | FACTOR 9991 | (LB) | | (LB) .0/35 |
| Ringer | <u> </u> | 15 . | 1.000 | | | C |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 4 | Σ03 | 0 | | _ | Σο | .0/3! |
| 'Al | | | | | | |

| SPACECRAFT Space Station | • |
|-------------------------------|--|
| Food | |
| HABITABILITY SUBSYSTEM Manage | ement HABITABILITY FUNCTION Galley Cleanup |
| APPLIANCE FUNCTION Dishwasher | r/Dryer Combination |
| APPLIANCE CONCEPT NO./TITLE | 10/Manual Wash-Manual Wipe Dry |
| • | |
| INDEX NO. 1.3.1.10 | REF. NO90 |
| | |

DESCRIPTION

In this concept, the dishes are sealed in a Teflon bag equipped with a rubber glove on both sides. The crewman manually scrubs the dishes by fitting his hands into the gloves. When washing is completed, excess water is squeezed out of the bag and the dishes are wiped dry with a towel. It is assumed, according to Reference 90, that 0.136 kg (0.3 lb) of water is wiped by the towel, and that a clothes dryer is available to dry the towel. For this purpose, clothes dryer concept 3.3.2.1 (forced hot air-electric) was assumed. Since the clothes dryer penalties were based on removing 0.454 kg (1.0 lb) of water, the penalties for that concept were multiplied by 0.3 and added to this dishwasher/dryer concept.

| • | 113) EiEC | IRICAL : | POWER | REQUIRE | MENTS | | |
|-----------------|---------------------------|--------------------------------|------------------------------------|---|----------------------------|----------------------------|----------------------------------|
| | | A (| | • | D_C | POWE | R |
| component (REF) | USE YIME CYCLE (HR) | PEAK (WATTS) | ③ AVERAGE (WATTS) | DEFIAND (WAIT-HR/ CYCLE) ① X ③ | (MATTS) | 6 AVERAGE (WATTS) | (7) DEMAN (WATT-H CYCLE) ① X (7) |
| | | | | | | | |
| | | | | | | • | |
| · •. | | MAXIHUM | | TOTAL | MAXIMUM , | ŕ | , TOTAL |
| | · | I H E R M A L | REQUI | R <u>emenis</u> | | | |
| SOURCE | | LATENȚ (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| Vate heat los | <u>s (40°F)</u> | <u>o</u> . | _12 | 00 | 1200 | | 0 |
| Towel dryer | • | | | | 109 | _ | 203 |
| | | • | | | 252/100 | | |
| · | TOTAL | WATT (BTU/HR) | WATT (| BTU/HR) | 352 (1200 WATT (BTU/HR) | | <u>9 (2 07</u> T (BTU/HR) |
| • | , | | | : | | | |
| • • • • | ! | R <u>PERAIIO</u> | LAL PE | Halies | | | ٠. |
| SOURCE. | , HEA (BTU/HR | THERMAL T LEAK TO /CYCLE) (BTU | COOLANT I/HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | WEIGHT CLE) (LB/MISSIC | | 3/WISSION) AOF ME |
| | | | | | | | |
| | | | | | | | |
| 7(| OTAL WATE (BTU) | S/CYCLE WA | TTS/CYCLE U/HR/CYCLE) C2-106 | • | KG/MISSIC (LB/MISSIC | M H ³ M) (FT | /MISSION) |

| | FIXED | METEH1 | NTOFNW | <u>EREQU</u> | <u>IREMEN</u> | <u>1 </u> | |
|----------------|------------------------|-------------------|----------------|----------------------|-----------------------------------|--|------------------------------|
| COMPONENT | (REF) |) | W | EIGHT (LBS) | | | VOLUME (FT ³) |
| Truly wich | · | | | 20 | | | 10 |
| Touch driver | | | <u> </u> | 2 <u>4</u> | | | 5.3 |
| Dicher / Wilne | er / chr. | - | | 1:5.5 | | | 0.01 |
| | | | | | | | |
| | | | | | | | , |
| | | | | | | | |
| | | | | | | | |
| | | - | | | | | |
| | | | | | | | |
| PAGE T | · TOTAL | | 26. | <u>8 (57)</u> | | 0.4 | 6 (11. |
| GINAL OTTALITY | ā. | • | KG | (LBS) | | | M3 (F)(3) |
| GINAL PAGE I | | ·. | | | | | |
| | ZOTID EX | PENDAB O |) | | EQUIREM | (A) | <u></u> |
| | O | WT/UNIT | (REF) | WT/CYCLE | VOL/U | MIT (REF) NL/UNIT)(REF) | (5) VOL/CYC V (4) |
| TYPE | UNITS/CYCLE(REF) | (LB | ·) , | ①x② (LB) | (1.0.10 | FT ³) | (FT3) |
| Deteracai/ | 1 | (1015 | | .018 | $-\frac{\rho}{T_{\bullet}^{(0)}}$ | 15.17.44 15.23 | · Dink |
| germicide | | | | | | | |
| | | | - | | | | |
| | | | | · | | | |
| | | | | | | | |
| | | | | | | | |
| | | • | Σ 3 | TOTAL WITCH | · · | Σ⑤ | TOTAL VOL/ (FT3) |
| 70041 100 | | | | , (LB) | | | · (FT3) |
| MISSION 3 | x | 194 | x | .019 | - | 4 | 5 (9.9 |
| CYCI | ES/DAY D | MAZ/WIZZION | 10 | OT.WT/CYCLE (LB) | | | KG (Lb) |
| TOTAL VOL | | 104 | | 00052 | • | 0.00 | 85 (0. |
| CYCI | ES/DAY ^ D | AYS/MISSION | ^ - | T.VOL/CYCLE (FT3) | - | | No (FTO) |
| | | | | (814) | | | · |
| • | | | | | • | | • |
| • • | <u>e v 2/r 1 d n 1</u> | D EXP | ENDABL | | RUIREME | | _ |
| | | Φ | | ② OVERY | ANT . RECOVERE | D/CYCLE | ANT LOST C |
| TYPE | . AMT.USED/ | CYCLE(REF) LB) | - | CTOR | Øx(2 |) | Φ. (J |
| Wach water | | 15 | 90 | 291 | | | .0135 |
| Rinse water | | 15 | _1.00 | 0 | | - | |
| | | | - | | | - | |
| | | | | | · | | |
| | | | | | | - | |
| | Σ 03 | <u>0 - </u> | | • | | Σ \odot . | .012. |

| HABITABILITY SUBSYSTEM_ | 1.0 | Food Management |
|--------------------------|-------|------------------------------|
| HABITABILITY FUNCTION | 1.3 | Cleanup |
| APPLIANCE FUNCTION | 1.3.2 | Dishwasher/Dryer with Dishes |
| NUMBER OF CONCEPTS CONSI | DERED | 12 . |

ASSUMPTIONS

All the automatic dishwashing data found have been for single integrated washer/dryer units. Three washings per day were assumed, with 6.80~kg (15 lbs) of water used for washing and 6.80~kg (15 lbs) for rinsing. It is assumed that 0.14~kg (0.30~lb) of residual water remains on the dishes after washing to be removed by the dryer. Washing time and drying time are each assumed to take one hour.

The amount of dishes required by the crew, assuming an automatic dishwasher/dryer is aboard, was computed and included with the washer/dryer penalty. This was necessary to compare with the disposable dishes. The packaged weight and volume of the dishes were taken from the disposable dishes study (see results in Table C2-5). The total dishes/utensils/cups required with the dishwasher for a six-man crew is 6.9 kg (15.2 lbs) and 0.023 cu m (0.81 cu ft).

The four highest rated dishwasher/dryer concepts from the trade studies performed for appliance function 1.3.1 were selected to trade with eight of the highest rated disposable dishes cases.

| CONCEPT | 1 | . Com | CONSUMBLES AND FLOR | ND FLOR | - EE | DUIREMENTS | THERMAL | THERMAL REUNTS | ELEC PBH | REUNTS | | BT/VOL "KEUMTS" " | ¥ | "RESUPPL |
|---------|----------|-------|---|---------|---------------|------------|---------|---|----------|---------------|---------|--------------------------|--------|-----------------------|
| 9 | 1145 | , | | | | | | | | | | | •••••• | • • • • • |
| | | | ANT | £: 0.4 | PRESS | 16.89 | COOLANT | HT LEAK | # U W | 7 7 Y | WE 16HT | FOLUME | | NE 16HT |
| | MRS/USE. | | -46/056- | : : | 15 IS | -016 C- | -MATTS- | -BATTS- | 0C | 0C -4ATTS- | -K6" | -C 2- | | (165) |
| | • | • | • | | | | | • | • | | | | ; | |
| - | 3.000 | : | . 01010 | .00 | • | °. | | 371. | 150.0 | | 71.9 | | | 7.7 |
| . | 2.000 | - 1 | 73000001 | -100 | _t10). | - 60. | | (1268.) | 75.0 | | | 106.19. | | |
| • | 3.000 | | 13.4040 | 000 | • • • | • • | 247. | 371. | 324.0 | 000 | (179.6) | 1 24.501 | 05 | (0.71 |
| • | 3.000 | • | 13.4680 | .00 | | 00 | 331.1 | 348. | 174.0 | | 77.6 | 47. 4.17. 4.17. E. 27.00 | 0 75 | 1.7 |
| | 3.000 | • | 13.6060 | 90. | 0.0 | 0.0 | | 151. | 22.0 | 0. | 100.43 | 1 15.30 | 96 0 | 17.7 |
| • | 88 | - | | | i | | .00 | .00 | 00 | | 230.5 | 105-10-)- | 0 10 | 230.5 |
| | 000 | | | | | • | .00 .1 | • | 0.0 | 00 | 265.9 | 1210-012 | 0. 10 | 245.9 |
| - | 000 | | | | - | | 000 | 00.1 | 00 | •• | \$30.0 | 2.65 | 0 0 | 230.5 |
| • | 000 | | | | ORI | , | | • | 0.0 | • • | 547.03 | (225.00) | 01 0 . | 1 587.11 |
| • | 000 | | | POO | GIN | | 00.0 | | 00 | | 156.9 | 1. 9.70) | 0 10 | 157.0 |
| 9 | 000 | | | R QU | AII P R QU | | | | • • | ••• | 192.3 | 3.44 | | 192.45 |
| = | .303 | | | MI | AG. | | | • | | 00 | 157.4 | **** | 0 0 | 157.4 |
| 21 | 0000 | | | T | | | | 0.0 | 0.0 | 00 | 142.8 | 4.25 | 01 0 | 192.0 |

| | R (CIRCULATED), LITERS/SEC (FT ³ /MIM) (10ST) , KG/HR (LB/HR) (10ST) , KG/HR (LB/HR) (10ST) , KG/HR (LB/HR) (10ST) , KG/HR (LB/HR) (10ST) , KG/HR (LB/HR) (10SED) , KG/HR (LB/HR) (10SED) , KG/HR (LB/HR) (10SED) , KG/HR (LB/HR) (10SED) , KG/HR (LB/HR) | (***)AVAILABLE INDICATOR AVAILABLE 0-25% STATE OF THE ART 25-50% SCAME DEVELOPMENT REQUIRED 50-75% EXTENSIVE DEV. REQUIRED 75-100% | | |
|---|---|--|----------|-----------|
| | (*) 1 - CABIN AIR 2 - CABIN AIR 3 - OXYGEN 4 - COLLIG WATER 5 - WATER 6 - NITROGEN 7 - NITROGEN 9 - WATER | UTENSILS (1) (2) (3) (4) | | |
| | SPRAY-CERTRICUSE DRVING SPRAY-CERTRICUSE DRVING SPRAY-FORCED MOT AIR ELECTRIC ME SPRAY-FORCED MOT AIR ELECTRIC ME SPRAY-FORCED MOT AIR ELECTRIC ME SPRAY-FORCED MOTORICE METALLIC UTENSILS-RE LE CUPS AND MONMETALLIC UTENSILS-RE LE CUPS AND MONMETALLIC UTENSILS-RE LE CUPS AND MONMETALLIC UTENSILS-RE LE CUPS AND MONMETALLIC UTENSILS-RE LE CUPS AND MONMETALLIC UTENSILS-RE | REUSABLE CUPS AND METALLIC UTENSILS AND METALLIC REUSABLE CUPS AND METALLIC UTENSILS ABORETALLIC REUSABLE CUPS AND METALLIC UTENSILS AND DISHES REUSABLE CUPS-DISPOSABLE MONNETALLIC UTENSILS AND DISHES | OR GREAT | PAGE TO A |
| c | 2000 2000 2000 2000 2000 | • • • • | | |

APPITANCE CONCEPT NO.

11

()

CONCEPT NAME

HOT WATER SPRAY-CENTRIFUGE DRYING

HOT WATER SPRAY-FORCED HOT AIR ELECTRIC HEAT DRYING

HOT WATER SPRAY-FORCED AIR/DISICCANT/ELECTRICALLY HEATED

MANUAL WASH-MANUAL WIPE

DISPOSABLE CUPS-REUSABLE METALLIC UTENSILS AND DISHES

OISPOSABLE CUPS AND NONMETALLIC DISHES-REUSABLE METALLIC UTENSILS

OISPOSABLE CUPS AND NONMETALLIC UTENSILS-BEUSABLE METALLIC DISHES

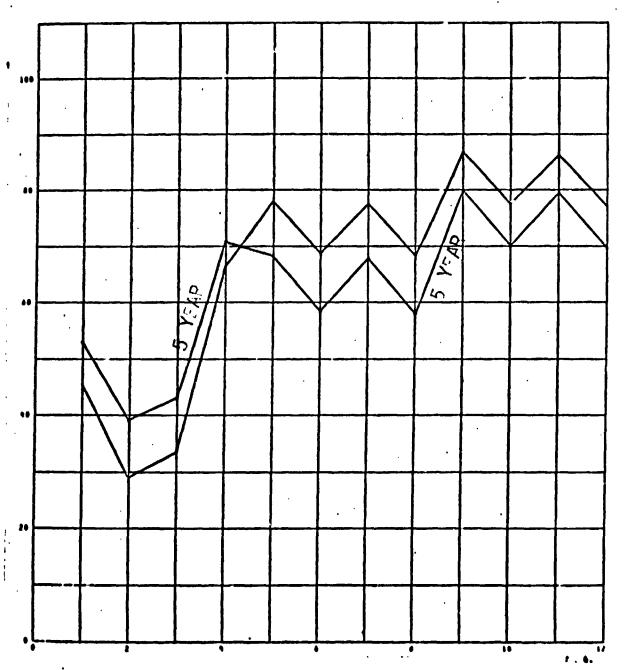
HEUSABLE CUPS AND MONMETALLIC UTENSILS AND DISHES

REUSABLE CUPS AND METALLIC UTENSILS AND DISHES

REUSABLE CUPS AND METALLIC UTENSILS-DISPOSABLE NONMETALLIC UTENSILS

REUSABLE CUPS AND METALLIC UTENSILS-DISPOSABLE NONMETALLIC UTENSILS

REUSABLE CUPS-DISPOSABLE NONMETALLIC UTENSILS AND DISHES



CONCEPT NUMBER

Dishwasher/Dryer with Dishes (Space Station)
Concept Trade
C2-111

| MAX VALUE PTS 1 2 | } { | - - - | | 1 | | | | - | | |
|---|-------------|-------------|-----------|--------|--------------|--------|-------|-------------|--------|--------|
| 19-01 54-101 51 56-7-5 | 2 | | • | - | | | 2 | | 2) - | |
| CA. 17 7 71 16 111 | 10.62 12.28 | | •05 | 1.99 | 00. | •1.4 | 4.1.4 | 6.13 | * * | - |
| | | 15.00 | 15.00 | | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | |
| 19.70ng 225.00 10 8.91 8.91 | 8.80 9.32 | | | - 5.84 | • 00 | 9.51 | 3.73 | 9.16 | 3.33 | |
| THERMAL .00000 207.77 15 3.23 .00 | 2.08 3.12 | | 15.00 1 | 2.00 | 00.51 | 15.00 | 15.00 | 15.00 | 15.00 | |
| 1.0000 5 1.93 | 00 3.30 | - 00.5 | | 2.00 | 5 •00 | 5.00 | 2.00 | 5.00 | 2.00 | |
| **** | | | | 2.00 | 2.00 | 5.00 | 2.00 | 5.00 | 5•00 | |
| 00000 2.0000 5 2.5000 | 2.50 5.00 | | | 5.00 · | 5 • 00 | 5.00 | 2.00 | 5.00 | 00.5 |); |
| 75.303 15 2.00 5 | | 13.00 | _ | 3.00 | 3.00 | 13.00 | 13.00 | 13.00 | 13.00 |): |
| *************************************** | 28-43_56.39 | i | ĭ | - 1 | 58.00 | 73.73_ | 65.90 | 73.29 | -65:47 | |
| | 33-45 66-34 | 77.95 | 68.73 _ 7 | 1 | | 96.74 | 77.53 | 66.23 77.03 | 77.03 | 85 |

i

· (_)

おからのはない というない ないかい かんしょう かんしょう

The transfer of the transfer o

| SENSITIVITY ANALYSIS SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING ACTOR BY 50 8 SELECTION PARAMYTER REIGHTING FACTOR BY 50 8 SERSITIVITY ANALYSIS SERSITIVITY A | | ORIGINA OF POO | B QU | AGE 14.53 60.77 65.77 | 49 R2,55 73.02 | 00-70 M3-40 M3-5 | #.j> #/.j4 /6:6 #.j7 #6.62 77:6 | 17 86.62 77.6 | 8.27 86.26 77: | | • | | | 10 11 12 | 77,53 66,23 77.03 | 2.34 90.61 81.6 | 67 68.84 50 64.84 50 | 5.35 84.89 74.8 | 6.85 85.81 76.3 6.85 85.81 76.3 | 6.85 85.81 74.3 |
|--|---------|---|---|-----------------------|----------------|------------------|------------------------------------|---------------|----------------|--------|-------------|---|-----------|----------|-------------------|-----------------|-------------------------|-----------------|------------------------------------|-----------------|
| SENSITIVITY ANALYSIS SELECTION PARANCTOR REIGHTING ACTOR BY LEASED ON 100 6 MAX POINTS) LEASED ON 100 6 MAX POINTS) LEASED ON 100 6 MAX POINTS) 22.20 36.47 67.60 72.72 63.17 72.24 22.20 36.47 67.60 72.72 63.17 72.24 22.20 36.49 64.34 77.95 66.73 77.45 22.20 36.49 64.34 77.95 66.73 77.45 22.20 36.49 64.34 77.95 66.73 77.45 22.20 36.49 64.20 72.72 63.17 72.24 22.20 36.49 64.20 72.72 63.17 72.24 22.20 36.49 67.62 79.74 71.27 79.74 22.20 36.49 67.62 79.74 22.20 36.49 67.62 79.74 22.20 36.49 67.62 79.74 22.20 36.49 67.62 79.74 22.20 36.49 64.37 77.95 22.20 36.49 64.37 77.95 22.20 36.49 64.37 77.95 22.20 36.49 64.20 75.20 22.20 36.49 64.97 77.95 22.20 36.49 64.97 77.95 22.20 36.49 64.97 77.95 22.20 36.49 64.97 77.26 22.20 36.49 64.97 77.26 22.20 36.49 64.97 77.26 22.20 36.49 64.97 77.26 22.20 36.49 67.60 22.20 36.49 67.20 22.20 36.40 | | . 0 | • | 8.24 86.7 | 2.70' 83.0 | 0.61 67.2 | 0.14 m/.0 | 9.14 87.1 | 9.73 86.7 | | | | , | | .24 06.7 | 4.84 91.1 | 5.14 MS.4 2.50 M6.1 | P-58 VI-5 | 7.27 86.3 | 7.27 06.3 |
| SENSITIVITY ANALYSIS SELECTION PARAMETER WEIGHTING [BASED ON 100 6 MAX POINTS 2 3 47 47.40 72.72 24.57 33.45 46.34 77.45 24.57 33.45 46.34 77.45 24.57 33.45 46.34 77.45 24.57 33.45 46.33 77.74 24.57 33.45 46.33 77.74 24.57 33.45 46.33 77.74 24.57 33.45 46.33 77.77 24.57 33.45 46.33 77.77 24.57 33.45 46.33 77.77 24.57 33.45 46.33 77.77 24.57 33.45 46.33 77.77 24.57 33.45 46.34 77.45 24.77 23.45 46.34 77.45 25.70 27.45 46.34 77.75 25.70 27.45 46.34 77.75 25.70 27.45 46.35 77.26 27.72 33.45 46.35 77.26 27.72 33.45 46.35 77.26 27.72 33.45 46.35 77.26 27.72 33.45 46.35 77.26 | | INCREASING ACTION BY | . , | 0.73 77 | 7 72. | . 9. | 27 /7. 62 78. | 62 78.n | 0.18 78.1 | | • • • | 2 . | | • | .77 | 5.37 A3. | 75.2 | 75.2 | 78 76.7 | 78 76-7 |
| SELECTION SELECTION 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | ANALYSI | N CONCEPT AFTER AMETER WEIGHTING LOO 6 MAX POINTS | - W - W - W - W - W - W - W - W - W - W | .34 77. | 67-60 72-72 | P/**/ 24*/4 | 66.13 78.54 | 66-20 78-58 | .24 78.4 | | AHAL YS! | H CONCEPT AFTER AMETER WEIGHTING 100 % MAX POINTS | 0 % C 6 7 | | .34 . 77.75 | **** | 64.62 75.82 | 70.75 75.82 | . 66.35 | . 65.32 |
| | SENSITI | ATING FOR SELECTION (BASED | | .42 33. | 7 | 77 | 32. | 35 | 700.7 | , , | SENSITI | ATING FOR SELECTION (BASED | í | | .72 33. | | | | - 1 | |

C2-113

10 (5.35

| NIN | 102/04/75] LUE FTS 1 2 3 4 5 6 6 11 12 LUE FTS 1 2 3 4 5 6 6 11 11 12 LUE FTS 1 2 3 4 5 6 6 11 10 11 12 LUE FTS 1 2 3 4 5 6 6 11 10 11 11 12 LUE FTS 1 2 3 6 6 11 10 10 12 12 12 12 12 12 11 12 1 | AAK LUE FTS 1 2 3 4 4 5 4 6 7 6 6 6 6 7 7 6 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 | 1 1 |
|---|--|---|-----------------------------------|
| MALK WALUE PTS : 2 3 4 5 6 7 8 6 7 8 6 10 11 12 SA7-DG : 15 10.95 : 10.41 : 10.62 : 12.28 | ##### F75 1 2 3 4 6 E F 7 4 6 1 1 1 1 2 | #### PTS 2 3 | |
| \$87.00 15 10.95 10.41 10.62 12.28 2.01 .02 1.99 .00 6.16 4.17 6.13 4.14 5.11 24 15 7.73 6.10 15.00 15. | \$67.70 \$ 10.95 0.91 10.05 12.28 2.01 .02 1.99 .000 15.00 1 | \$47.00 15 10.95 10.41 10.62 12.28 2.01 15.00 1 | 1 11 |
| 225-00 15 7-73 -00 4-43 12-31 15-00 | 225.00 22 | 225.00 10 8.91 8.91 8.93 7.73 .00 15 | ** .00 6.16 4.17 6.13 4. |
| 9.7003 225.00 10 8.91 8.91 8.92 4.24 15.00 | ************************************** | 225.00 10 0.91 0.91 0.92 1.32 1.32 1.30 15.00 15 | 00 15.00 15.00 15.00 15.00 15. |
| .00000 207.77 15 3.28 .00 2.00 5.00 5.00 5.00 5.00 5.00 5.00 | -8107 15 3.24 .70 2.00 5.00 5.00 5.00 5.00 5.00 5.00 5.0 | 207.77 15 3.28 .00 2.00 3.11 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5 | 15.00 15.00 15.00 15.00 15. |
| .00000 | 100000 2.000 5.00 5.00 5.00 5.00 5.00 5.0 | 1.0000 5 1.37 112 100 3.07 5.00 5.00 5.00 5.00 5.00 5.00 5.00 5 | 00. \$-00 \$-00 5-00 5-00 5-00 |
| .00000 2.0000 15 2.60 .00 2.50 5.00 13.00 | 2.0000 5 2.50 .00 2.50 5.00 5.00 5.00 13.0 | 2.0000 5 2.50 .00 2.50 5.00 5.00 5.00 5. | 00 \$-00 B-00 B-00 B-00 B-00 |
| 10.000 75.000 15 2.00 5.00 .00 4.00 13.00 | 17.010 55.000 15 2.00 5.00 0.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 13.00 10.0 | 75.000 15 2.00 5.00 .00 4.00 13.00 13.00 13.00 13.00 6.15 4.16 5 567.10 15 14.57 14.57 2.02 10.2 1.09 .00 70.61 70.00 70 100.00 100 53.04 37.12 43.00 70.77 40.27 50.44 47.02 50.00 70.04 70.00 | 5.00 5.00 5.00 11.00 11.00 11.00 |
| 17.010 56710 15 17.57 17.57 48.27 56.44 67.62 58.00 79.63 70.02 79.42 69.61 .00000 100.00 100 53.04 39.12 43.00 70.77 48.27 58.44 67.62 58.00 79.84 70.06 79.42 69.61 | 17.010 56710 15 50.00 70.07 46.27 56.44 67.62 56.00 70.63 70.00 70.42 69.41 67.62 56.00 70.63 70.04 70.42 69.41 60.000 100.00 100 53.04 30.12 43.00 70.77 46.27 56.44 67.62 56.00 70.64 70.42 69.41 | 100-00 100 \$3.04 39.12 43.00 70.77 48.27 \$6.44 47.62 \$6.00 79.63 70.06 79 | 99 |
| 100.00 100 53.04 39.12 43.00 70.77 48.27 58.44 47.82 58.00 79.84 70.04 79.42 49.41 | -00000 100-00 100 \$3.04 39-12 43-00 70-77 40-27 56-44 67-62 56-00 79-84 70-02 49-61 | 100.00 100 \$3.00 30.12 43.00 70.77 40.27 50.00 27.62 50.00 70.00 70.00 70.00 | 58.00 79.63 70.00 79.42 69.61 |
| | | | .82 58.00 79.88 70.06 79.42 69.61 |
| GINAI POOR | | PAQUA | |
| GINAL PA POOR QUA | PAQUA | GI | |

(,

C

O

K: v

| SEMSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFTER INCREASING FORESCHOOL PARANETER WEIGHTING FACTOR BY CONTROL OF THE CONTROL | 80 8 80 8 80 8 8 8 8 8 8 8 8 8 8 8 8 8 8 | 0 74.8 2 77.17 2 80.57 2 80.57 2 80.57 5 77.17 | 10.00 70.00 70.00 72.15 70.70 70.70 71.22 | 7 4 4 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 | 12 ••••1 ••••0 71-73 71-73 71-73 70-35 70-35 70-35 70-35 70-35 70-35 | D2-118 |
|--|---|---|---|---|---|--|
| SENSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFTER INCRE SINGLE SELECTION PARAMETER WEIGHTING FACT (BASED ON 100 S MAX POINTS) 1 | 50 50 50 50 50 50 50 50 50 50 50 50 50 5 | 7 2 3 6 3 6 3 6 3 6 3 6 3 6 3 6 3 6 3 6 3 | 0 | 7 0000000 | 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| ### FACH CONCEPT AFTER INCRE | 80 80 80 80 80 80 80 80 80 80 80 80 80 8 | * | 0 | 7 0000000 | 12 46 46 71 71 71 71 70 70 90 90 90 90 90 90 90 90 90 9 | |
| MORNAL \$3.09 39.12 43.00 70.77 66.27 58.94 AEIGMT 54.93 41.24 44.93 71.54 64.45 54.38 POACH 52.93 36.39 42.04 71.54 64.45 54.38 POACH 52.93 36.39 42.04 71.54 64.45 54.38 THERMAL 50.80 38.23 41.95 70.54 69.05 59.46 BAINTEMC 52.91 38.23 41.95 70.54 69.05 59.46 BAFETT 55.96 38.17 43.17 71.48 69.05 59.46 BAFETT 52.96 38.17 43.17 71.48 69.05 59.46 BAFETT 56.31 43.17 46.77 72.61 64.45 54.38 RATIMG FOR EACH CONCEPT AFTER INCREAS | | * | 0 | 7 0000000 | 12 20 21 21 21 21 21 21 20 20 20 20 20 20 20 20 20 20 | |
| \$3.04 39:12 43.00 70:77 66:27 58:44 52:43 36:39 42:04 71:54 64:45 54:38 52:43 36:39 42:04 71:54 64:45 54:38 52:43 36:39 42:04 71:54 64:45 54:38 52:45 36:39 42:04 71:54 64:45 59:46 52:45 36:39 42:05 70:56 69:05 59:46 52:45 36:45 50:46 52:46 | | 7 | 0 1 2 2 2 2 2 2 2 3 | 7 00000000 | 71.73 71.73 71.73 70.35 70.35 70.95 | |
| 54.43 41.24 44.43 71.54 64.45 54.38 52.43 36.29 42.06 71.56 70.49 61.34 51.76 41.50 45.14 71.64 68.00 55.85 50.46 52.76 41.50 40.97 67.28 70.49 61.34 52.96 38.23 41.95 70.56 69.05 59.46 52.41 38.23 41.95 70.54 69.05 59.46 52.96 38.17 71.48 69.05 59.46 50.27 38.72 40.00 69.55 69.05 59.46 50.27 38.72 40.00 69.55 69.56 60.41 50.11 43.17 46.77 72.61 64.45 54.38 56.11 43.17 46.77 72.61 64.45 54.38 56.11 43.17 46.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 72.61 64.45 54.38 56.11 63.17 65.77 | | 24 9 8 9 6 9 6 9 6 9 6 9 6 9 6 9 6 9 6 9 6 | | | 71-73 71-73 71-73 70-35 70-35 70-96 | |
| VOLUME 54.76 41.50 45.14 71.04 64.00 55.05 THERNAL 50.00 45.14 71.04 67.04 61.34 RELIANT 52.59 30.23 41.95 70.54 69.05 59.46 RAINTENC 52.41 30.23 41.95 70.54 69.05 59.46 SAFETY 52.96 30.17 43.17 71.48 69.05 59.46 DEV COST 50.27 30.72 40.00 69.55 69.56 60.41 REC COST 50.27 30.72 40.00 69.55 69.56 60.41 REC COST 50.11 43.17 46.77 72.61 64.45 54.38 RATIMG FOR EACH CONCEPT AFTER INCREAS | | 900 | | | 70.75 70.35 70.35 70.35 70.60 | |
| 50.86 36.37 40.97 67.28 70.49 61.34 52.57 38.23 41.95 70.56 69.05 59.46 52.41 38.23 41.95 70.56 69.05 59.46 52.42 38.17 43.17 71.48 69.05 59.46 50.27 38.72 40.00 69.55 69.56 60.41 50.11 43.17 46.77 72.61 64.45 54.38 RATING FOR EACH COMCEPT AFTER INCREAS SINGLE SELECTION PARAHETER REIGHTING FACTOR | 3 3 3 3 3 | 900 | | | 71-73 70-35 70-35 70-35 70-60 | |
| RAINTENC 52.41 38.23 41.95 70.54 69.05 59.46 54.05 COST 52.96 38.17 43.17 71.48 69.05 59.46 56.05 COST 50.27 38.72 40.00 69.55 69.56 60.41 R.C. COST 56.11 43.17 46.77 72.61 64.45 54.38 56.38 86.11 43.17 46.77 72.61 64.45 54.38 86.38 8 | | #0 #0 #2 | ~ ~ ~ ~ · · · · · · · · · · · · · · · · | | 700.15 | |
| SAFETY 52.76 38-17 43-17 71-18 69-05 50-14 0EV COST 50-27 38-72 40-00 69-55 69-54 60-41 AZC COST. 56-11 43-17 46-77 72-61 44-45 54-38 56-41 AZC COST. 56-11 43-17 46-77 72-61 44-45 54-38 56-41 AZC COST. 56-11 43-17 46-77 72-61 44-45 54-38 56-41 AZC COST. 56-11 43-17 46-77 72-61 44-45 54-38 56-41 AZC COST. 56-11 43-17 46-77 72-61 44-45 54-38 56-41 46-77 72-61 44-45 56-41 46-77 72-61 44-45 56-41 46-77 72-61 44-45 56-41 46-77 72-61 44-45 56-41 46-77 72-61 44-45 56-41 46-77 72-61 44-45 72-61 | 5 | 277 | V V | | 70.35 70.80 66.00 | |
| RATING FOR EACH CONCEPT AFTER INCREA | 3 | 7. | ~; - | - 1 | | |
| SENSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFTER INCREA SINGLE SELECTION PARAMETER WEIGHTING FACTO (BASED ON 100 S MAR POINTS) | | | | ; | | |
| RATING FOR EACH CONCEPT AFTER INCREA | | | | | | |
| RATING FOR EACH CONCEPT AFTER INCREASINGLESELECTION PARAMETER BEIGHTING FACTO 1805 & NAX POINTS) | ! | | | | | 350 |
| BASED ON 100 & MAX POINTS> | K6 50. 5 | | ; | | | ol4 |
| | | | • | ; | 4 4 | |
| 3 3 8 6 3 | | | | , | İ | |
| - | • | • | <u>•</u> | = | ~ | |
| HORMAL \$3.04 34.12 43.00 70.77 66.27 58.44 & | 7.82 58.00 | n 77.6 | 70.nt | 79.42 | | والمراقب المستقد والمراقب المستقد والمستقد والمستقد والمستقد والمستقد والمستقد والمستقد والمستقد والمستقد والم |
| 30-67 40-78 69-87 72-72 63-17 | .24 62. | 6.5.0 | | ŵ. | 3.0 | |
| 3 10-14 30-49 40-63 69-54 66-58 61-31 | .19 26. | 7.0.0 | • • | • | - s | |
| 42-30 45-36 74-82 65-70 55-97 | .21 540 | 78.2 | 7.4 | - | | |
| C \$3.70 _40.07, 44.10 71.01 67.46 57.38 | . 95 00. | | ` ` | | | |
| 50-12 40-13 42-82 70-02 67-45 67-45 67-45 67-45 67-45 67-45 67-45 | 24.42 | | 64.24 | 76.90 | 68.83 | |
| COST 49-46 34-42 10-61 60-43 72-72 63-17 | .24 62. | #3.0 | ** | | 3:0 | |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 1.3.2-DISHMASHER/DRYER COMBINATIONS WITH DISPOSABLES (PAGE 1 OF 2)

NUMBER CRITICAL SAFETY ITE1S ij DESICCANT CANISTER ٠. , z w HEATER DC . ŧ N O A X VIB BLOWER . . CONTROLLER TIMER 0 9 ပ • -HEAT EXCHANGER ц, 0 SILTER: ම ١. (CEAR BOX) œ ı • w MATER SEPARATOR 8 ≖ ⊃ ACCUMULATOR • ~ **AVLVE** 2 2 m ~ • • dwn • яотон(~ DISPOSABLE CUPS REUSABLE METALLIC KHIVES, FORKS, SPOCHS DISPOSABLE HOWETALLIC DISHES HOT WATER SPRAY-CENTRIFUGE DRYING DISPOSABLE CUPS REUSABLE METALLIC KUIVES, FORKS, SPOONS REUSABLE METALLIC DISHES SPOCKS REUSABLE NETALLIC DISHES COMPONENT TYPE HOT WATER SPRAY WASH-FORCED COLD A:R-DESICCANT-ELECTRICALLY PEATED (pg. 104) HOT WATER SPRAY WASH-FORCED HOT AIR ELECTRIC HEAT DRYING NOTITETALLIC KNIVES, FORKS, DISPOSABLE CUPS DISPOSABLE DISPOSABLE CUPS DISPOSABLE MANUAL WASH-MANUAL WIPE APPLIANCE TYPE (59. 102)

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 1.3.2-DISHWASHER/DRYER COMBINATIONS WITH DISPOSABLES (CONCLUDED) (PAGE 2 OF

5

CRITICAL SAFETY NUMBER ITEMS R DESICCANT CANISTER ŧ Z DC HEATER w 'n z 0 VIE BLOWER (8) ı 1 ۵ Σ TIMER TIMER 0 6 ı ¢ • HEAT EXCHANGER 4 0 6 FILTER (GEAR BOX) α w MATER SEPARATOR മ **©** Σ > **ACCUMULATOR** \bigcirc . **AVLVE** <u>@</u> 1 1 ı **GM**N4 (%) **AOTOM** COMPONENT TYPE REUSABLE CUPS REUSABLE METALLIC KNIVES, FORKS, SPOONS REUSABLE METALLIC DISHES REUSABLE CUPS DISPOSABLE
NGWAETALLIC KNIVES, FORKS,
SPOONS DISPOSABLE NOWMETALLIC
DISHES REUSABLE CUPS REUSABLE METALLIC KNIVES, FORKS, SPOONS DISPOSABLE NOWWETALLIC DISHES REUSABLE CUPS DISPOSABLE HOWFETALLIC KNIVES, FORKS, SPOCHS REUSABLE NOWMETALLIC DISHES APPLIANCE TYPE

| SPACECRAFT Space Station | · |
|--|---------------------------------------|
| Food | MADITABLE TTV CHICTION Colley Cicenus |
| HABITABILITY SUBSYSTEM Management | HABITABILITY FUNCTION Galley Cleanup |
| APPLIANCE FUNCTION Dishwasher/Dryer wi | th Dishes . |
| PPLIANCE CONCEPT NO./TITLE 1/Hot Wate | on Spray Contrifugo Drying |
| PPLIANCE CONCEPT NO./TITLE 1/HOC Water | er Spray-centrituge brying |
| INDEX NO. 1.3.2.1 | REF. NO. 90 |
| | |

DESCRIPTION

This is the same concept presented in Section 1.3.1.1. It is included here to compare with the case where no dishwasher/dryer is used and dishes are either disposable or hand-wiped clean.

| CONCEPT Hot water s | APPLIAN CITY - cer | ce concept requi itrifuje dry | rements and t ing | PENALTIES CALC | ULATIONS INDEX I | NUMBER 1. 3.2.1 |
|---------------------|-----------------------|----------------------------------|------------------------|------------------------|--|--|
| (Ref. #90 p9) | 3,9 <i>4</i>) | ŕ | | | | |
| | ELECI | RICAL P | | REQUIRE | | |
| | USE TIME | ② | (3) | R (4) DEMAND (WATT-HR/ | <u> </u> | POWER (b) DEMAND WATT-HE |
| COMPONENT (REF) | CYCLE (HR) | PEAK (WATTS) | AVERAGE (WATTS) | (Dx (3) | PEAK (WATTS) | AVERAGE CYCLE) (WATTS) ① X ② |
| Moto: | | 150 | | | <u> </u> | |
| Valves Pump | -0 | | | | <u>55 </u> | |
| <u> </u> | | | | | | |
| | | | | · | | |
| 4 •. | | ` | | | | |
| | | | | • | | |
| | | 4=0 | • | | | |
| | | 150 MAXIMUM | • • • | TOTAL | 75 MAXIMUM | TOTAL |
| | | | | | | • |
| | • | | | · | , | • |
| • | | • | • | • | ٠. | · • |
| | . 1 | LHERMAL | REQUIR | EMENIS | | • |
| • SOURCE | • | LATENT (BTU/HR) | SENS (BTU | | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
| Water heat loss (| (Look) | o · | 120 | ia) | 1200 |) '0 |
| | | 0 | | 1 × 1 | 68 | {7 -0 |
| Pump Motor | | 0 | 51 | | 512 |) -0 |
| Water (dry) | | 318 | <u> -31</u> | | 0 | 0 |
| Water Cory | | | | | | |
| ١ | • | | | | , | • |
| • | TOTAL . | 93 (318) | 372 | (1268) | 372 (1268 | ()) |
| • | • | MATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT (BTU/HR) |
| | • | . • | | • | •• | |
| • | | • : | | : | | • |
| | • | . • | | • | - : | • |
| •• | | • | | | | • |
| • | . δ | PERATION | AL PE | MALTIES | • | |
| ~ | · HEAT | THERMAL | COOLANT | ELECTRICAL | WEIGHT | VOLUME |
| SOURCE. | (BTU/HR/ | CYCLE) (BTU/ | HR/CYCLE) | (PK WATTS/CYC | | |
| | • | _ | ٠. | | • | • |
| /V / /\ | | | | | | |
| | | | 1 | | | |
| 1 | | | ******** | | | |
| | | | | | . | |
| | | | | | | |
| | TAL | | | | - | |
| | MATTS | /CYCLF WAT | TS/CYCLE /HR/CYCLE) | • | KG/H15510 (LB/H15510 | M M ² /MISSION M) (FT ² /MISSION) |
| . • | *. | , ,,,,, | . C2-119 | • | , | gr r grisamswidg |

| CONCEPT Hat water creay - centrit | REMENTS AND PENALTIES CALCULATIFIED Arying | ONS (CONCLUDED) INDEX NUMBER 1. 3.2.1 |
|--|--|--|
| | 2 / J <u>-</u> | |
| EIXED MEIG | HIVOLUME REQUIE | REMENIS . |
| COMPONENT (REF) | WEIGHT (LBS) | VOLUME (FT ³) |
| · Basic wacher /drier | 40 | |
| Punc | | .) |
| 2 Acqua delore | 11 | - () |
| Water caparator | 3 | |
| Packarin | 3.2 · | |
| Dishes/atinsels/sups | 15.2 | 0.41 |
| <u> </u> | | . <u>~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~</u> |
| | | |
| Total | · (| (052) |
| TOTAL | 50.3 (111) | 0.716 (25.3) |
| | KG (LBS) | M ³ (FT ³) - |
| - <u>SOLID EXPENDA</u> | BLE MT/VOL REQ | <u>UIREMENTS</u> |
| → VT/UN | O MI/CYCLE | VOL/UNIT (REF) VOL/CYCLE |
| · (PKG.WT | /UNIT)(REF) ①x② (LB) (LB) | (PKG.VOL/UHIT)(REF) (DX (FT3) |
| Detergent/ 1 | | .00044 .00052 |
| Germicide (.0) | 5) | (.00052) |
| * | | |
| | | |
| | | |
| | | |
| | 23 | · \(\sum_{\foral}\) \(\sum_{\f |
| TOTAL WT 3 x 184 | x .018 | 4.5 (9.9) |
| CYCLES/DAY DAYS/MISSI | | KG (L6) |
| MISSION - 3 x 144 CYCLES/DAY DAYS/MISSIO | x .00052 101.400/cvice (FT3) | 0.0085 (0.3) |
| | (FT?) | |
| | • | |
| FYNTIONID EX | | IREMENIS . |
| • | · ② · RECOVERY ANT | RECOVERED/CYCLE AMT LOST/CYCLE |
| AMT. USED/CYCLE (REF | FACTOR | |
| Wash water . 15 | . 9991 | |
| Rinse water 15. | | |
| | | |
| | | |
| | _ | |
| Σ030 | | $\Sigma \odot \underline{.0135}$ |
| TAT IL LIT | | |
| NISSION - 3 x DAYSMISSION X | 10/135 · 7.45 | · 30 • [17.0 (37.5)] |

| SPACECRALT | Space Station | · · · · · · · · · · · · · · · · · · · | • | |
|--------------|---|---------------------------------------|---|-----|
| HABITABILITY | SUBSYSTEM Food Manag | gement HABITABILITY FU | NCTION Galley Cleanup | |
| | | | | |
| APPLIANCE CO | NCEPT NO./TITLE 2/Hot | : Water Spray - Forced I | Hot Air Electric Heat Dryir | ıg |
| INDEX NO | 1.3.2.2 | REF. NO | 90 | • |
| here to com | : This is the same co pare with the case whe osable or hand-wiped o | ere no dishwasher/dryer | tion 1.3.1.3. It is included is used and dishes are | ied |

| CONCEPT Het water of | APPLIANO | ce concept requ h - for c | irements and ed hot a | penalties calc air elect | ulätiuns ric Index | NUMBER 1.3.2. | 2 |
|----------------------|---------------------|------------------------------|--|-------------------------------|-------------------------|---------------------------------------|--------------------------------|
| heat dry | ELECI | RICAL I | POWER | REQUIRE | MENTS | | |
| • | | A (| | • | 0 | POWER | |
| COMPONENT (REF) | USE TIME CYCLE (HR) | ② PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (WATTS) | AVERAGE (WA | (7) EMAND IT-HR, CLE) |
| Valvina · | _0. | | | ———— | 55 | ······ | , . |
| Fan | | 17 | | | • | | |
| Motor Heater | | 150 | • | | 271 | | |
| Pump | | | | · | 20 | | |
| • | | ' | | • | | | |
| | | | | | | | |
| | | 4.6- | • | | | • | |
| | | 167 . | • | 70741 | 326 MAXIMUM | | |
| • | | PARTITUM | . • | TOTAL | MAXIMUM | | OTAL |
| | . • | • | | • • | | • | |
| | | • | • • | | • | : | |
| • | | | • | | • | • _ | |
| | . 1 | HERMAL | KENNII | REMENIS | | • | |
| • | • | LATENT | SENS | SIBLE | HEAT LEAK | TO COOLA | TP |
| Pump source | • | (BTU/HR) | (BTL | 1/HR) 68 | (btu/hr) 68. | (BTU/HR) |) |
| Water heat loss (| 142°F) | O· | 12 | 00 | 1200 | {η ŏ | |
| Fan | | 0 | | 58 | 9 | 49 | |
| Motor | | 0 | | 22_ | 522 | 0 | |
| Heater | | 0 | | 33 | 140 | 793 | |
| Water (dry) | | 318 | <u>(-3</u> | 13) | | 1 0 | |
| | | | | , - | / | | . \ |
| | | 3.2 (318) | | | 372 (1260 | 247 (8 | ±=) |
| • | , | WATT (BTU/HR) | WATT_(| BTU/HR) | WATT (BTU/HR) | WATT (BTU/ | HR) |
| ٠ • | • | | | | | • | |
| • | | • | | : | • | • • | |
| • ., • | | | • | • ` , | · - | | |
| • | | | | · • | 1. | • | |
| · • | 2. | <u>Perailon</u> | AL PE | HALIIES | | • | |
| SOURCE. | HEAT I (BTU/HR/C | | COOLANT /HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | WEIGHT LE) (LB/MISSI | VOLUME ON) (FT ³ /MISSI | ION) |
| N/A | • | • | ٠. | | . • | •• . | • |
| | | • | —————————————————————————————————————— | | , . | | |
| | | | | ******** | | | |
| | | | | | | • | |
| | | • | | | - | • | |
| | | | | • | | | |
| 10 | TAL NATTS/ | CYCLE DAY | TS/CYCLE | | YE/MICE! | W MINISTER | 19 |
| | (BTU/HR | CYCLE) (BTI | J/HR/CYCLE) | • | KG/HISSI (LB/HISSI | ON) (FT 7/MISSI | ON) |

C2-122

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED) concept Hot water pray wash - forced hot air electric INDEX NUMBER 1, 2, 2, 2 (Ref. #90 p 102, 103) heat dry FIXED MEIGHT/YOLUME REQUIREMENTS WEIGHT (LES) COMPONENT Basic 45 Fan Pockacins Dishes / Hinenis /cups 1.21 241.5 ORIGINAL. PAGE 18 TOTAL (132)(25.3)OF POOR QUALITY KG (LBS) M3 (FT3) · EXPENDABLE WI/VOL REQUIREMENTS WT/UNIT (REF)
(PKG.WT/UNIT)(REF) MI/CYCLE VOL/UNIT (REF) VOL/CYCLE 0 ①x② (LB) (F13) (PKG.VOL/UNIT) (REF) UNITS/CYCLE(REF) (LB) <u>000</u>44 Defersent. 0005 Germicida TOTAL WY/CYCLE
. (LG) YOTAL VOLTCYCLE 1 84 DAYS/MISSION TOTAL VOL 000 52 0,0085 E A S/L 1 Q U 1 D EXPENDABLES REQUIREMENTS · ② AMT.RECOVERED/CYCLE ANT LOST/CYCLE 0 RECOVERY ANT.USED/CYCLE(REF) **FACTOR** · (LB) Wash 9991 0135 1.000. $\Sigma 0$. 30 Σ \odot . 0135 DAYS/HISSION 17.0 (37.5) t O

| SPACI CRAIT Spa | ce Station | · affiliant realistic de la se | . • | |
|------------------|---|--|---------------------------------------|-------------------------|
| HABITABILITY SUE | SYSTEM Food Manage | ment HABITABILITY F | UNCTION Galley Cl | leanup |
| APPLIANCE FUNCTI | ON Dishwasher/Dry | er with Dishes | | |
| APPLIANCE CONCER | T NO./TITLE 3/Not | Water Spray - Forced | Air/Desiccant/Des | o <u>rbed Electrica</u> |
| INDEX NO. | 1.3.2.3 | REF, NO | 90 | |
| nere co compare | nis is the same con- with the case where | cept presented in Sec e no dishwasher/dryen | ction 1.3.1.4. It is used and dish | is included es are |

| CONCEPT Het water . | pray | nce concept requi wash — foi | reed col | d air desi | ccant INDEX | NUMBER 7. | <u>5.2.2</u> _ |
|---------------------------------------|-----------------|---------------------------------|---|--------------------------|-------------------------|---------------------------------------|----------------|
| (Ref. # 90 p 10 | 4-106) | IRICAL E | | | u rute | | |
| | FFFF | TUTE T | <u> </u> | REQUIRE | D (| PONE | R |
| • | USE TIME | <u> </u> | ③ | DEMA:ID | 3 | © | DEMAN |
| • | CYCLE | PEAK | AVERAGE | (WATT-HR/ CYCLE) | PEAK | AVERAGE | (WATT-H |
| COMPONENT (REF) | (HR) | (WATTS) | (WATTS) | Ox O | (WATTS) | (WATTS) | ①×C |
| Meter: | _1 | 150 | | | • | | |
| For Valves | 3 | 24 | | | <u>.5.5</u> | | |
| Pulmiz | | | • | | <u> </u> | | <u></u> |
| Heater | | | | | 90 | | |
| • • • | | • | | · | | | |
| • | | | | | | | • |
| | | • • | | | 165 | • | |
| | | 174 | • | | 145 | | · |
| | | MAXIHUM, | • | TOTAL | MUMIXAM | • | . TOTAL |
| ••• | | | • | • | | | ÷ |
| | • | • | | | • | • | • |
| : | | | • | • | | | |
| | | IHE "HAL" | REQUI | REMENIS | • | | • |
| | | LATENT | . SEN | SIBLE | HEAT LEAK | 10 | COOLANT |
| SOURCE | | (BTU/HR) | | U/HR) | (BTU/HR) | | BTU/HR) |
| Water heat loss (4 | (00-) | 0 | 12 | 00 | 1200 | 1 | O |
| Aump | | 0 | | 58 | 58 | -{ ₁ — | 0 |
| Motor | | 0 | | 12 | 512 | -) | 0 |
| | | 0 | | 82 | 12 | - | (70) |
| Fan Heater | | 0 | | 07 | 46 | - - | 261) |
| Water (dry) | | 3/8 | -31 | 8 | | - | |
| TO CALLY | DTAL | 93.2(314) | 369 | (1258) | 369 (125 | دري ^ل (۲ | Z (331 |
| • | | WATT (BTU/HR) | | (BTU/HR) | WATT (BTU/HR) | • | (BTU/HR) |
| • | | . • | • | | • | • | |
| • | • | • | • | | | • | |
| • | • | . • | | • • , | | • | • |
| | • | • | • • • | _ | • • | | • |
| . • | | PERAILON | AL PE | MALILES | • | | |
| | • | THERMAL | | | • | | |
| SOURCE. | HEAT (BTU/HR | LEAK TO | COOLANT /HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | MEIGHT LE) (LB/MISSI | | MISSION) |
| , | | ,01022 | , | (** m | • | • • • • • • • • • • • • • • • • • • • | • |
| <i>N/A</i> | | ' | <u>:-</u> | | _ ` | | · · |
| · · · · · · · · · · · · · · · · · · · | | · | | · | . — | - | |
| | | | | | | | · |
| • | | | | | | | |
| · | | | · . | | | | **** |
| • | | - | • | | . — | • | |
| . 101/ | WATT | S/CYCLE WAT | TS/CYCLE | | KA/MISSI | ON MY | MISSION |
| | (810/ | HR/CYCLE) (BT) | J/HR/CYCLE) | | (LB/MISSI | ON) (FT | (MISSION) |

concept Mot suitor apray wash - forced cold air desiceant index number 1.3.2.3

| | EIX | | F.E H IVA O F | WEIGHT | UIREMENI. | | VOLUME |
|-------------------|------------------|---------------------------|------------------|----------------------------|------------------|---------------------------|-------------------------|
| COMPONENT | | (REF) | | (LBS) | | | (LL3) |
| Basic nache | r/drys | <u> </u> | | 11-0 | | | |
| Perp | ··· | · | | 4 | | | |
| | <u> </u> | | | | | | |
| Valuin | | | | <u>_</u> | | | |
| Water :: p.y. | | | | 3 | | | |
| Desiccont' be | <u> </u> | | . —— | | | | _ |
| Fou | | | | 34 | | - | |
| Packaging | | | | 15.2 | - | | 0 (1 |
| Diches Julin | 50 5/ 0 | cre- | | 12./. | | - | 0.01 |
| 101 (L/ | | | | | | <u>`</u> | 27.0 |
| | TC . | TOTAL | · ر ج | (= (10 11) | | 0.74 | (2 - 1) |
| RIGINAL PAGE | 10 | TOTAL . | | 6.2 (124) | | 0.787 | |
| F POOR QUALF | | | | KG (LBS) | | N ₁ | (FT3) · |
| • • | | | •• | : | | • | |
| | \$0110 | | DABLE | | EQUIREM. | ENTS | <i>`</i> |
| | _ | WT | /UNIT (REF) | MI/CYCLE | VOI /UN | <pre>(4) IT (REF)</pre> | (S) VOL/CYCLE |
| | 0 | (PKG | .WT/UNIT)(REF |) (Dx(2) | (PKG. VOL | /UNIT)(REF) | ①x @ (F13) |
| Tolowall | UNITS/CYCL | E(REF) | (LB) | (LB) . C18 | | T ³) | |
| Defersent / | | | .015 | | | <u> </u> | 100057 |
| Germinide | | | | | | | |
| • | | | · | - | | | • |
| • | | | | | | | |
| | | | | _ | | | |
| | | | | | | | |
| | | | | <u> </u> | | | |
| • . | | | Σ | D | • | Σ \mathfrak{G} . | ,000,000 |
| • | | | | TOTAL WI/CYC | LE | | TOTAL VOL/CYCLE |
| TOTAL NT. MISSION | | | | • | ٠, | | |
| MISSION 3 | S/DAY | x <u>194</u> days/hi | <u> </u> | O199 YOY.HT/CYCLE | _ • | 4. | 5 (9.9) |
| · CICLE | .S/UAT | DA12/HI | 2210st | (LB) | • | , KG | (LB) |
| TOTAL VOL | | | , | • | | | |
| MISSION VOICE | 3 :S/DAY : | x <u>1 Q Z</u> DAYS/HI | revou x - | .00052 101.VOL/CYCLE | _ ૅ઼ા | 0.008 | <u>5 (0.3)</u> (117) |
| | | . UN13/FI | 3310H | (FT ³) | • | m- | 161-7 |
| •. | | | • | : | • | • | |
| • | | | | | • | | |
| • • • | E V PVF I | <u>Q U I D</u> | EXPENDA | Prez BE | QVIREME! | <u>! I s</u> | |
| | . • | Φ | | Ø | ANT . RECOVERED. | | ANT LOST/CYCLE |
| • | . AK | | REF) · | RECOVERY | Ox 2 | CYCLE | MI LOSIZETELE |
| TYPE | ••, | T.USED/CYCLE(| | TACTOR | (LD) | | (LB) |
| Wash water | | 15 | | 9041 | | | .0135 |
| Rinse water | | 15 | | 000. | | | |
| | | | | | | | · |
| | | ** | | | | | |
| | | | | | | | |
| • | | | | | | | |
| • ** | $\Sigma \odot -$ | 30 | | • | | $\Sigma \odot$ _ | .0135 |
| 4 | | | • | • | | | • |
| | | | - . | | | | |
| MISSION 3 | | 184 | | 75 -1 | 15 . 3! | | 17.0 (27.5) |

| SPACECRAFT | Space Station | · | | |
|--------------|--|--|---|------------|
| HABITABILITY | SUBSYSTEM Food Manag | ement HABITABILITY | FUNCTION Galley | Cleanup |
| APPLIANCE FU | CTION Dishwasher/Dr | yer with Dishes | Acres 1 00000000000000000000000000000000000 | |
| APPLIANCE CO | ICEPT NO./TITLE 4/Man | ual Wash - Manual Wi | pe Dry | |
| INDEX NO | 1.3.2.4 | REF. NO. | 90 | |
| to compare w | This is the same co oncept which is manua ith the case where no r hand-wiped clean wi | lly operated by a cro dishwasher/drver is | ewman. It is inc used and dishes | Judad have |

| NCEPT Manual was | <u>sh = mai</u> 119) | nual wife. | dry . | | INDEX N | JMBER 1.3.2.4 |
|----------------------------|--------------------------|--------------------|---------------------------------------|-----------------------------|----------------------------|---|
| theti is i | • | RICAL | POWER | REQUIRE | MENIS | |
| | USE TIME CYCLE | ② PEAK | C . POWE O AVERAGE | DEMAND (WATT-HR/ | U C SJ PEAK | POWER (5) DEMAY AVERAGE (WATT-) CYCLE |
| mponent (ref) fauch dryer: | (HR) | (HATTS) | (NATTS) | ①x③ Cx((t)) | (HATTS) 68 | (WATTS) ①X(|
| | | | | | | |
| | | · | | | | |
| | _ | MAXIMUM. | • | TOTAL | MAXIMUM , | TOTAL |
| | • | • | • | • | • | • |
| | • | <u>lherhal</u> . | REQUIE | EMENTS | | • |
| SOURCE | • | LATENȚ (BTU/HR) | | SIBLE D/HR) | MEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
| later heat loss | 5 (40°F) | 0 | | 00 | 1200 | |
| owel dryer | | | | | 109 | _203 |
| | | | | | | |
| | Total | WATT (BTU/HR) | UATT (| BTU/HR) | 352 (1200) | |
| | • | • | | | MATT (BTU/HR) | MATT (BTU/HR |
| ·. · · | • | • | | | | • , |
| | · | PERAILO | MAL PE | Naliies | | •• |
| ••• | | THEMAL | | | • | • |
| SOURCE. | HEAT (BTU/HR) | LEAK | TO COOLANT TU/HR/CYCLE) | ELECTRICAL (PK WATTS/CYC | MEIGHT CLE) (LB/MISSION | VOLUME 1) (FT ³ /MISSION . • |
| N/A | | | •• | | | · |
| | | | | | - | |
| | | <u> </u> | · · · · · · · · · · · · · · · · · · · | | | |
| 70 | TAL WATE | S/CYCLE I | MATTS/CYCLE | | KG/M15510M | M ³ /MISSION |

| npunent Such discount | (REF) | | (LBS) | | VOLUME (FT ²) |
|----------------------------------|------------------|-----------------------|-------------------------------------|-----------------|--|
| iches fulling | is/sups | - - | 24 15.2 | | <u>5.3</u> 0.01 |
| | | | | | |
| , | | · - | | | |
| | · TOTAL | . Ľ | 26.8 (59 6 (LBS) | <u>.</u> | 0.46 (16.1) N ³ (FT ³) |
| ·*• . | | MIAINIT | E MINOL (REF) MINOL | | N T S (REF) YOU/CYCLE |
| eternant/ | UNITS/CYCLE(REF) | (PKG.NT/UN) (LB) | (1)(REF) (1)%(2) | (PKG. YOL/U | NIT)(REF) (DX (C) |
| ermicide | | | | | |
| | | | | | |
| | • | | Σ③ <u>τοιλι ψίζο</u> (LB) | war · | Σ (F13) |
| • | IS/DAY X N | 194 NYSTHISSION | 1 - 0 / C: YOT, WY/EVELE (LB) | _ · _ [| 16.5 (9.7) 16 (th) |
| AL VOL 3 LISSTON 2 3 EVELT | ESZDAY X DA | 1 0 4. (VS/MISSION | 1 00052 101. Val/CYCL (FT') | | 0.0085 (0.3) |
| | EVENTIONII | . KEPI | HPARLES R | EQUIRENEN: | |
| TYPE | AMT.USED/O | | RECOVERY FACTOR | MIT.RECOVERED/C | $\mathbf{Q}_{(\mathbf{s})}^{(\mathbf{s})}$ |
| lach water inse water | | <u> </u> | 1.000 | • | |

| SPACECRAFT Space Station |
|---|
| HABITABILITY SUBSYSTEM Food Management HABITABILITY FUNCTION Galley Cleanup |
| APPLIANCE FUNCTION Dishwasher/Dryer with Dishes |
| APPLIANCE CONCEPT NO./TITLE 5 through 12/Disposable-Reusable Dishes |
| INDEX NO1.3.2.5 through 1.3.2.12 REF. NO. 100, 174, 177, 250, 276 |
| DECORTATION |

DESCRIPTION

A detailed study was made of the food utensils, trays, and cups to determine the optimum selection from among a wide variety of possible combinations. The possible choices considered in each case are explained in the following paragraphs.

CUPS

<u>Disposable nonmetallic</u>. This is a prefilled collapsible plastic bellows type of cup used on Skylab. The cup is disposed of after use. Data for this case were taken directly from the Skylab cups (Reference 250). The number of cups used was based on the initial Skylab launch value of 1610 cups for 420 planned man-days.

Reusable metallic. This method of drinking resembles drinking from a cup with a straw as on Earth. It was tried on Skylab and was found to be quite satisfactory if the right size of straw is used. Data for this case were taken from Reference 276. It was assumed each man had two cups. One wet and one dry wipe were assumed to be used for each cup use, with the number of cup uses the same as for the disposable nonmetallic case.

UTENSILS - KNIFE/FORK/SPOON

Disposable metallic. This case was included for comparison purposes, althought resulted in a very high penalty for Space Station. Utensil weight and volume for stainless steel utensils, as on Skylab, were taken from Reference 250 and 177. It was assumed one knife/fork/spoon set per man for each meal was used, with no spares.

Reusable metallic. The same utensils as in the above case were assumed, with one wet wipe per man per meal allowed for cleaning as on Skylab. Since Skylab had three extra utensil sets (Reference 250) for a three-man crew, it was assumed one extra set was allowed per man.

<u>Disposable nonmetallic</u>. Data for this case were taken from References 174 and 177, with a 10 percent packaging factor included. One set per man per meal was assumed.

SERVING TRAYS

Two basic types of trays were considered: (1) ordinary dish type and (2) food warming trays. It was assumed the dish type of tray would be used with bulk food packaging, while the warming trays would be used with individual food cans.

APPLIANCE CONCEPT NO./TITLE 5 through 12/Disposable-Reusable Dishes (Continued)

SERVING TRAYS (Continued)

For direct comparison, a food packaging penalty was added to the warming trays to account for the individual food cans. These penalties were taken from Reference 276 for the food mix assumed in this study shown previously for the Food Habitability System 2.0. The resulting penalties are shown in Table C2-3.

Reusable heating type. This concept assumed reusable metallic covers for a heating tray, with two wet wipes and one dry wipe allowed to clean the cover. Data for the covers were from Reference 177, and include a 10 percent packaging factor. The food packaging penalty described previously for individual cans was added to the total weight and volume for this case. Based on the Skylab use of five food trays for a three-man crew (Reference 250), it was assumed ten heating tray covers allowed for the Space Station case and six for Shuttle.

Reusable metallic dish. Data for the dishes in this case were identical (Reference 177) to the reusable heating tray covers discussed previously, except that bulk food is assumed here with no packaging penalty. Again, two wet wipes and one dry wipe were assumed to clean the dishes per man.

<u>Disposable metallic dish</u>. Weight and volume for this type of dish were assumed the same as for the two previous cases. One dish per man per meal was assumed, with no wipes. Bulk food packaging was assumed; thus, no packaging penalty was added.

<u>Disposable nonmetallic dish.</u> Data for this case are identical to those for the disposable metallic dishes above except for dish weight. Dish weight was estimated using the same ratio used previously for metallic and non-metallic utensils.

The data for all the above cases are tabulated in Table C2-4 for the Space Station. The best eight combinations were chosen by inspection, as indicated in the table, and included in the trades. To compare these cases with a dishwasher/dryer concept, a set of reusable utensils/dishes/cups used with the washer/dryer was selected from the above cases. The number, weight, and volume for these items are shown in Table C2-5. These penalties were added onto the basic washer/dryer penalties to provide direct comparison in the trades. The four best dishwasher/dryer concepts from appliance function 1.3.1 were selected for trade with the eight disposable dishes concepts.

TABLE C2-3
PENALTIES ASSOCIATED WITH VARIOUS TYPES OF DISPOSABLE DISHES CONCEPTS
FOR SPACE STATION SIX-MAN CREW

| DISPO | SABLE DISHES - TYPE | NUMBER | PACKAGED WEIGHT kg (1b) | PACKAGED VOLUME cu m (cu ft) |
|-----------------------------|---|--------------------|--|---|
| | Disposable Nonmetallic VEHICLE PENALTY | 4140 | (283.) 128. | (78.5) 2.22 |
| CUPS | Reusable Metallic Wet Wipes Dry Wipes TOTAL VEHICLE PENALTY | 12 4140 4140 | (3.0) (77.0) (41.1) (121.) 55. | (.28) (1.78) (1.64) (3.70) .105 |
| | Metallic Disposable Utensils VEHICLE PENALTY | 3240 | (806.) 366. | (27.3) .773 |
| KNIVES/ FORKS/ SPOONS | Metallic Reusable Utensils Wet Wipes TOTAL VEHICLE PENALTY | 12 3240 | (2.9) (60.3) (63.2) 28.7 | (.11) (1.39) (1.50) .0425 |
| | Disposable Nonmetallic Utensils VEHICLE PENALTY | 3240 | (64.1) 29.1 | (10.7) .303 |
| | Reusable Heating-Type Tray Covers Wet Wipes Dry Wipes Food Packaging Penalty TOTAL VEHICLE PENALTY | 10 6480 3240 | (9.3) (120.6) (32.2) (562.) (724.) 328. | (.42) (2.78) (1.29) (52.7) (57.2) 1.62 |
| TRAYS | Reusable Metallic Dish-Type Tray Wet Wipes Dry Wipes TOTAL VEHICLE PENALTY | 10 6480 3240 | (9.3) (120.6) (32.2) (162.) 73. | (.42) (2.78) (1.29) (4.49) .127 |
| | Disposable Metallic Dish-Type Tray VEHICLE PENALTY | 3240 | (3030.) 1374. | (136.) 3.85 |
| | Disposable Nonmetallic Dish-Type Tray VEHICLE PENALTY | 3240 | (240.) 109. | (136.) 3.85 |

TABLE C2-4

ORIGINAL PAGE TO OF POOR QUALITY

VEHICLE PENALTIES FOR VARIOUS DISPUDABLE DISHES CONCEPTS ASSUMING NO DISHWASHER AVAILABLE

| | S F C S I G V S C G S F C | U F C (TVDE) | | | | | |
|--------------------------|---------------------------|--|--------------------------------------|-----------------------------------|----------------------------------|------------------------------|---------------------------|
| | | 2 1 | S | PACES | TATIO | z | |
| cuPs | KNIVES, FORKS, | · TRAYS | WEI | GHT | V 0 L | E E | CONCEPT |
| | SPOONS | | LBS | KG | CU FT | ₩ CO | NUMBER . |
| | DISPOSABLE METALLIC | REUSABLE HEATING TYPE REUSABLE METALLIC DISH DISPOSABLE METALLIC DISH DISPOSABLE NOWMETALLIC DISH | 1813.0 1251.0 4119.0 1329.0 | 822.4 567.5 1858.4 602.8 | 163.0 110.3 241.8 241.8 | 3.12 6.85 6.85 | * * * * |
| DISPOSABLE | REUSABLE METALLIC | REUSABLE HEATING TYPE REUSABLE METALLIC DISH DISPOSABLE METALLIC DISH DISPOSABLE NOWMETALLIC DISH | 1070.2 508.2 3376.2 586.2 | 485.4 230.5 1531.4 265.9 | 137.2 84.5 216.0 216.0 | 3.89 6.12 6.12 | 1.3.2.5 |
| · | DISPOSABLE NONYETALLIC | REUSABLE HEATING TYPE REUSABLE METALLIC DISH DISPOSABLE NETALLIC DISH DISPOSABLE NOTMETALLIC DISH | 1071.1 509.1 3377.1 587.1 | 485.9 230.9 1531.9 266.3 | 145.4 93.7 225.2 225.2 | 2.15 6.38 8.38 | 1.3.2.7 * 1.3.2.8 |
| ************************ | DISPOSABLE METALLIC | REUSABLE HEATING TYPE REUSABLE METALLIC DISH DISPOSABLE METALLIC DISH DISPOSABLE NOWMETALLIC DISH | 1651.0 1039.0 3957.0 1167.0 | 748.9 494.0 1794.9 529.4 | 88.2 35.5 167.0 | 2.50 1.01 4.73 4.73 | * * * * |
| REUSABLE METALLIC | REUSABLE METALLIC | REUSASLE HEATING TYPE REUSASLE METALLIC DISH DISPOSABLE METALLIC DISH DISPOSABLE NOWHETALLIC DISH | 908.2 346.2 3214.2 424.2 | 412.0 157.0 1458.0 192.4 | 62.4 9.7 141.2 141.2 | 1.77 0.27 4.00 4.00 | 1.3.2.9 1.3.2.10 |
| | DISPOSABLE NONMETALLIC | REUSABLE HEATING TYPE REUSABLE METALLIC DISH DISPOSABLE KETALLIC DISH DISPOSABLE NONMETALLIC DISH | 909.1 347.1 3215.1 425.1 | 412.4 157.4 1458.4 192.9 | 71.6 18.9 150.4 150.4 | 2.03 0.54 4.26 | * 1.3.2.11 1.3.2.12 |

*These concepts were not pursued further due to large penalties.

TABLE C2-5

WEIGHT AND VOLUME OF DISHES/UTENSILS/CUPS TO BE USED
WITH AUTOMATIC DISHWASHER/DRYER FOR SPACE STATION SIX-MAN CREW

| | NUMBER | PACKAGED WEIGHT Lg (1b) | PACKAGED VOLUME cu m (cu ft) |
|-----------------------|--------|----------------------------------|---------------------------------------|
| DISH/TRAY | 10 | 4.2 (9.3) | 0.0119 (0.42) |
| KNIVES/FORKS/SPOONS | 12 | 1.3 (2.9) | 0.0031 (0.11) |
| CUPS | 12 | 1.4 (3.0) | 0.0079 (0.28) |
| TOTAL VEHICLE PENALTY | | 6.9 (15.2) | 0.023 (0.81) |

HABITABILITY SUBSYSTEM

2.0 Personal Hygiene

APPLIANCE FUNCTIONS CONSIDERED

- 2.1.1 Fecal Collection/Transfer
- 2.1.2 Urine Collection/Transfer
- 2.1.3 Vomitus Collection/Transfer
- 2.2.1 Whole Body Shower
- 2.2.2 Partial Body Washing
- 2.2.3 Partial Body Drying
- 2.3.1 Shaving
- 2.3.2 Hair Cutting
- 2.3.3 Nail Care
- 2.3.4 Dental

DESCRIPTION

The personal hygiene habitability subsystem provides for waste collection/ transfer, body cleansing, and personal grooming. The concepts selected for trade included consideration of the zero-gravity effect on liquid flow and containment, the elimination and/or control of contamination which is easily spread in a zero-gravity environment, and the disposal of waste products within the spacecraft in the absense of the normal terrestrial sewers/septic tanks. These requirements must be satisfied with maximum safety and minimum weight, volume, and use of consumables. Waste collection appliance functions accommodate all of the bodily waste functions. Both partial and whole body washing techniques were considered during the study. The remaining personal hygiene appliance functions presented are for such crewman functions as shaving and hair cutting. The appliance concepts were evaluated to be functionally adequate and acceptable to the crewmembers from both physiological and psychological aspects prior to including them as viable concepts.

The fecal and urine collection/transfer appliance functions were considered separately for the purposes of trade studies. The two functions would most probably be combined for a space vehicle because of the attendant reduction in weight, volume, power, and thermal.

| HABITABILITY SUBSYSTEM 2.0 Per | rsonal Hygiene |
|--------------------------------|------------------------|
| #ABITABILITY FUNCTION 2.1 Was | te Collection/Transfer |
| APPLIANCE FUNCTION 2.1.1 Fec | al Collection/Transfer |
| NUMBER OF CONCEPTS CONSIDERED | 9 |

ASSUMPTIONS

1 !

- (1) The fecal collection/transfer concepts consider wet, dry, chemical, decomposition, and incineration methods for disposing of fecal waste.
- (2) The study assumed one defecation per day per man. The concept use time required per defecation is dependent on the concept type.
- (3) Filter weight and volume were included if a high replacement frequency is required. Periodic filter replacement was not included in the study.
- (4) Component power requirements were normalized to provide a fair comparison of all concepts. The power requirements were not based on the latest fecal collector designs. This was done because the various manufacturers were in process of a competitive proposal response for the Shuttle waste collection system and could not be contacted for additional information.
- (5) Overboard venting was not allowed with the exception of nonfilterable gases. Concepts were modified to satisfy this requirement by adding a vacuum pump to the concept.
- (6) Fecal collection concepts requiring a day for decomposition of wastes and cooldown were allocated at one per crewman. The remaining concepts were provisioned at one per vehicle.

| | A WD. Z.Ist | | feces | .colfctlow | • | TRANSFER ISPACE | SPACE | STATIONS | - | , | | | | | ı | |
|-------|---------------|----------|---------------------|--------------|---------|-----------------|-------|----------|------------------|-------------|---|-----------|---------------|---------------------|----------|--------|
| 0#CEP | 7 4386E | 1 | CONSUMBLES AND FLOW | RNO PLON | ¥ | QUIRENENTS | | THERMAL | THERMAL REGNTS - | | ELEC.PHH.AEGHTS | 3 | WT/VOC REGHTS | DEVELOPHENT COST | TRESUPPE | 1344 |
| : | 1 1 | | ANT | | | 45.4 | : | TWA LOOK | # 1.E.A.K | | A 4 6 4 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 | # E 1 G H | YOLUME | AVAIL INDE | • | #E16HT |
| | H45/USE | 3 | -K6/USE- | • • | TENENT. | 17042 | :[| -84715- | -#ATTS- | OC FATTS | 0C | 1587) | 111 031 | [•••] | - | 15871 |
| | | | | | | | | | • | | | • | • | | | |
| - | 000 | | | | 0 | | | | 200 | 675.0 | | 7.46.7 | . • 5 | . 52 2 | | \$7.6 |
| • | | | 10000 | 20 | - | - | 6 | | - | 0.54 | \$2.0 | 314.03 | 23 | | - | 127.01 |
| | | - | 00000 | .00 | - | - | 1.1 | | | | | | | ! | i | · |
| | 0.000 | _ | . 8008 | | | 21.1 | - | ÷ | 474. | .0.0 | 0.07 | 237.0 | | 2 30 | | • |
| | - 4118. | - | .00000 | -20.30) | • | - | 70.01 | 1:0 | -1101911 | 0.026 | 3.0.0 | 1 522.67 | 5 | } | 7 - | 462-23 |
| | | • | 1,4969 | 1966 88.41 | 1034.3 | + | ~ 6 | | | | | | | | | |
| | ; | | 9000 | 00 | 155104 | • | - 6 | i | ! | ; | | | | 1 | ; | |
| ! | 1 | | 0000 | | | • | | | | | | | | • | | |
| | 00000 | - | 0000. | 20.03 | ••• | ; = | 73:01 | • | 1.2.0 | 0.00 | 260.0 | 450.4 | 2.12 | | - | 623.03 |
| | | | | | | | 1 | | | | | - 1 | | | | |
| • | 0000 | - | 110000 | - 100-02-1 | 0 | - | 70.01 | | 151200 | 1142.0 | 1132.0 | (0.814) | 100-1411 | | - | 241.03 |
| | . 000.4 | - | .2631 | 00 | | | i | 0 | 1170 | 0.005 | 0.00 | 508.0 | 5.34 | . 59 6 | | 364.6 |
| | 000. | - | 1.0000 | _ | - | - | 10:0 | | 1 | | - | | | | - 1 | |
| • | 4.000 | - | 11325 | 000 | 0) - | - | 70.01 | ••• | 1498- | 500.0 | 340.0 | 354.1 | 10.5 | 3 70 | 7 | 215.9 |
| - | 2.000 | - | . 35001 | .00-6205 | 12058-0 | 1 1 73.01 | 100 | 00 | 1050. | 704.0 | 380.0 | (1785.0) | 1220.00 | . 3 75 | 2 1 | 523.41 |
| • | 6.000 -125 | - | 00000 | 4.25 4.25 | 00-1- | 21.1 | 10. | 0 - | *00* (2760+) | 600+0 | 245.0 | 249.9 | . 61 | 01 | | 154.7 |
| | ••000 | | | | | | • | • | 0 | : | 1 | 122.2 | **** | 0 | 1 | 122.0 |
| | 0000 | | GF | ORI OF | | | | | - | | | - 1 | - | | 1 | |
| | | | 0 | OD. | | | | | | į | | | 1 | | i | |
| | | | OR | IAI | | | | | | | i | | | | | |
| | | | Q | P | | | | | | | | | | | | |
| | | | UA | ▲ G | | | | | | | | | | | | |
| | | | | j | | | | | | | | | | | | |

| (` | | 3 | | | |
|-----|------------------------|---------------------------------------|--|-----------------------------|---|
| C | NCEPT NO. | 1 - CABIN AIR 2 - CABIN AIR | (CIRCULATED), L | /SEC | _ |
| 0 | 2 - DRT JOHN GAST | ATER | (CIRCULATED), K | KG/HR (LB/HR) KG/HR (L5/HR) | |
| 0 | INTEGRATED FLORE FLORE | N N | (CIRCULATED), N (USED) (CIPCULATED), N | | |
| 0 | V N 4 | | (PROCESSED) . P | KG/HR (LB/HR) | |
| 0 | ORT BAGS (APOLLO) | (**)AVAILABLE | | (***)COST INDICATOR | ì |
| 0 | | (1) AVAILABLE (2) STATE OF TY' ART | | 0-25% | |
| O | | | REQUIRED EQUIRED | 50-75% 75-100% | |
| | | | | | |
| , , | | | | | |
| , | OF | | | | |
| | IGIN PO | | | | |
| | OR | | | | |
| | PAG | | 1 | ı | |
| V | | , | | | |
| ١ | | 1 | , | | |
| 9 | | | | | |
| 736 | | . , , | i † 1 | : | |
| 71 | | | | • | |

..... APPLIANCE CONCEPT . NO.

CONCEPT

DRY JOHN DRY JOHN-ANAL WASH GERHICIDE

INTEGRATED VACUUM DECOMPOSITION

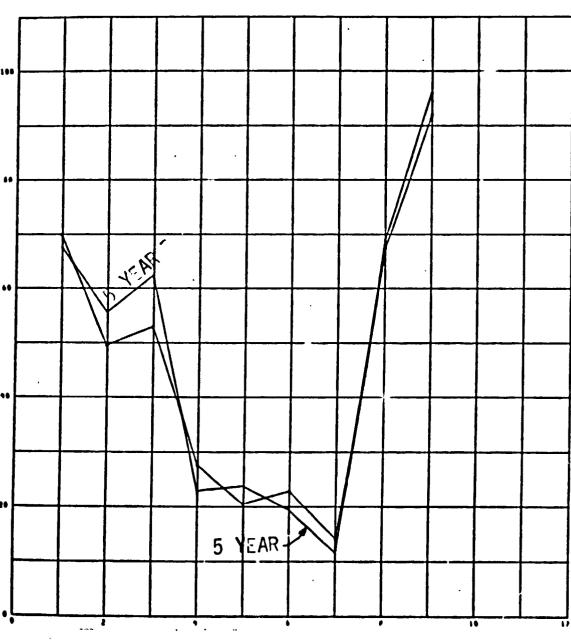
ELUSH FLOW OXYGEN INCINERATION

PYROLYSIS/BATCH INCINERATION

WET OXIDIZATION

SEMIAUTOMATIC BAG SYSTEM (SKYLAB)

- DRY BAGS (APOLLO)



CONCEPT NUMBER

Fecal Collection/Transfer (Space Station) Concept Trade

| SELECTION NATRIL * * * * * * * * * * * * * * * * * * * | SELECTION MATRIX MALUE VALUE 264.40 1785.0 19.0000 1063.0 19.0000 22.46.36 19.0000 22.5000 19.0000 22.5000 19.0000 22.5000 19.0000 22.5000 19.0000 22.5000 10.0000 22.5000 10.0000 22.5000 10.0000 22.5000 10.0000 22.5000 | ************************************** | -8747000 | 2 | 8 | 200000000000000000000000000000000000000 | 0.0000000000000000000000000000000000000 | 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | *0*000000 |
|--|---|--|---|---|---|---|---|---|-------------------|
| 245.40 (178.00 15 12.33 10.41 7.20 9.41 5.59 9.40 .00 10.37 12.74 10.00 10.35 12.75 10.00 10.35 12.75 10.00 10.35 12.75 10.00 10.35 12.75 10.00 10.35 12.75 10.00 10.35 12.75 10.00 10.35 12.35 | VALUE VALUE 7 264.40 1785.0 19.0000 1063.0 19.0000 226.50 000000 255.16 000000 75.000 000000 65.000 | 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | 23.00 | Z 0770N7007 7 | 25 25 THE PERSON TO THE PERSON | 2 | 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - | 1 1 1 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 | * 0 * 0 9 9 9 9 9 |
| 28**0 1785.0 15 12.33 10*41 7.20 9*41 5:59 8*40 *00 10:37 12.74 *000000 10:30 12.5 4:46 10.66 10.66 10.0000 10:30 12.5 4:46 10.66 10.66 10.0000 10:30 12.5 4:49 6*91 10:0000 1 | 266.40 1785.0 19.0000 1063.0 19.0000 24.60 100000 10000 100000 2.0000 100000 2.0000 100000 10000 100000 10000 | ## ## ## ## ## ## ## ## ## ## ## ## ## | 7.2 10.6 13.1 2.0 2.5 5.0 5.0 | 0 7 1 0 N 1 0 7 1 1 0 7 1 0 7 1 0 7 1 0 7 1 0 7 1 0 7 1 1 0 7 1 1 0 7 1 1 1 1 | 10.55 10.03 | 20 00 00 00 00 00 00 00 00 00 00 00 00 0 | 000 | 1 12. 1 15. 2 2 5. 3 5. 2 61. | * 0 * 0 9 9 9 9 9 |
| 1,000 | .00000 10000 .00000 10000 .00000 100000 .00000 100000 .00000 100000 .00000 100000 | 4.844 4.844 10.000 10.000 10.000 | 2.50 | 7 7 0 0 7 7 0 7 7 | 1 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - | 3. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. | 9 9 7 7 8 8 9 9 7 8 9 9 9 8 9 9 7 8 9 8 9 | 2 | |
| -00000 | ************************************** | 0000 000 000 000 000 000 000 000 000 0 | 2.52 | - NM 6 | 3.03 2.27 2.50 2.50 0.29 3.67 | - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4. | 1 15. 2 5. 3 5. 0 5. 2 8 1. | |
| ************************************** | .00000 Z .0000 .00000 Z .0000 .00000 D Z .0000 .00000 D Z .000 | 10.00 | 2.5 | 7 5 C 7 T | 2.50 2.00 2.00 0.29 | 6 - 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 00 5 00 13 | 2 6 5 | 9.99 |
| .00000 75:000 15 10:00 9:00 6:00 3:00 2:00 1:00 :00 13:00 15:00 .00 13:00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 15:00 .00 .00 .00 .00 .00 .00 .00 .00 .00 | .00000 15.000 .00000 65.000 | 10.00- | 53.1 | 7 7 | 2.00-29 | | 9.85 58 | 2 81. | |
| .00000 100.00 100 67.65 55.61 62.46 22.65 23.67 19.48 11:59 67:09 96.35 | 00.001 000.00 | 67.65 55. | | 3 | 3.87 | 44.0 | 4 63. | | |
| | | | 61 62.4 | • | | | | . 96 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | - | | |
| | | | | | | | | | |
| | | | | | | | | 1 | |
| | | | | | | | | | |

| 100 | SENSITIVITY ANALYSIS | |
|--|--|-----|
| ### COUNTRY OF THE PROPERTY OF | EACH CONCEPT AFTER INCREASING PARAMETER MEIGHTING FACTOR BY SD. ON 100 B HAX POINTS) | |
| ### \$5.55 \$5.61 \$2.00 \$2.05 \$2.07 \$10.00 \$1.55 \$0.07 \$0.35 #### \$5.50 \$2.00 \$2.00 \$2.00 \$2.00 \$2.00 \$1.00 \$0.00 \$ | | |
| ### \$5.60 62.0 | 2 3 4 5 6 7 | |
| ### Section 1.51 22.13 22.14 10.55 0.00 95.42 #################################### | 67-65 55-61 62-48 22-85 23-87 19-48 11-59 69-09 96-3 | |
| ### 1915 1915 2115 2117 2117 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 2110 2717 | F 68.83 56.83 61.31 26.33 24.96 22.44 10.65 69.09 95. | |
| ### 12.00 | ************************************** | |
| ### SECRETARING FOR \$2.77 19.44 11.52 49.45 #### PARTING FOR EACH CONCEPT AFTER INCRESSING #################################### | | |
| ### SENSITIVITY ANALYSIS ### SENSITIVITY ANALYSIS ### FOR EACH CONCEPT AFFER INCREASING ### F | | |
| ### ### ############################## | 31-35-48-10:02-23:02-13:02-18:44-10:05-10: | |
| ###################################### | | 856 |
| 67.65 55.61 62.48 22 65 23.87 19.48 11.59 69.09 96 66.24 54.15 63.68 18.74 22.58 15.94 12.71 69.08 97 66.24 54.15 63.68 18.74 22.58 15.94 12.71 69.08 97 66.56 54.38 62.20 23.38 24.32 18.35 12.31 67.95 96 65.81 54.37 60.06 25.07 23.49 20.07 10.58 68.20 96 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 67.70 57.29 62.62 22.63 23.78 18.54 11.94 68.15 94 67.75 55.18 64.66 22.63 23.08 18.56 11.94 68.15 94 | ACM CONCEPT AFTER INCHEASING PARAMETER REIGHTING-FACTOR BY-50- IN 100 8 MAX POINTS! | 1.4 |
| 67.65 \$5.61 62.48 27 85 23.87 19.48 11.59 69.09 96 66.24 54.15 63.88 18.74 22.58 15.94 12.71 69.08 97 66.22 57.97 61.68 24.77 23.49 21.37 10.69 71.35 96 66.56 54.37 60.06 25.37 23.49 21.35 96 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 66.77 54.42 61.41 23.10 24.43 20.07 10.59 68.17 96 69.70 57.29 62.86 22.03 23.08 18.56 11.94 68.15 96 67.75 55.18 64.66 23.13 24.85 20.72 12.71 67.39 96 | 4 S W C C P T | |
| 66.24 54.15 63.86 18.74 22.58 15.94 12.71 69.06 97 65.22 57.97 61.66 -24.77 -23.49 -21.37 -10.69 -71.35 -96 66.56 54.36 62.20 23.38 24.32 18.35 12.31 67.95 96 66.77 54.42 61.27 -21.35 -9.81 71.31 67.95 96 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 66.77 57.27 62.86 22.03 23.08 18.56 11.94 68.15 96 67.70 57.27 62.86 22.03 23.08 18.56 11.94 68.15 96 67.75 55.18 64.66 -23.13 -24.87 -20.72 -12.71 67.39 96 | 67-65 55-61 62-48 27 85 23-87 19-48 11-59 69-09 96-3 | |
| - 64.22 - 57.97 - 61.66 - 24.77 - 23.49 - 21.37 - 10.69 - 71.35 - 96 - 65.61 - 54.37 - 60.06 - 25.38 24.32 18.35 12.31 67.95 96 - 65.61 - 54.37 - 60.06 - 25.07 - 24.23 - 21.36 - 9.61 71.31 - 96 - 64.77 54.42 61.41 23.10 24.43 20.07 10.56 68.20 96 - 64.77 54.92 61.41 23.10 24.43 20.07 10.56 68.20 96 - 67.03 57.27 62.66 22.03 23.08 18.56 11.94 68.15 96 - 67.75 - 55.16 - 64.66 - 23.13 - 24.85 - 20.72 - 12.71 - 67.39 - 96 | 66.24 54.15 63.86 [8.74 22.58 [5.94 [2.7] 69.08 97. | |
| 66.77 54.37 60.06 25.07 24.43 20.07 10.58 68.20 76 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 76 69.70 57.27 62.66 22.03 23.08 18.56 11.94 68.15 76 69.70 57.27 62.66 22.03 23.08 18.56 11.94 68.15 76 67.75 55.18 64.66 23.13 24.85 20.72 12.71 67.39 96 | 640.22 -57097 610.68 240.77 230.49 210.37 100.69 710.35 96 | |
| 66.77 54.42 61.41 23.10 24.43 20.07 10.50 60.20 70 60.03 57.02 63.00 70 60.03 57.02 63.02 63.00 10.50 11.50 60.00 70 60.70 57.27 62.65 22.03 23.00 10.54 11.94 60.15 70 67.75 55.10 64.06 22.13 23.00 10.54 11.94 60.15 70 67.75 55.10 64.06 23.13 24.07 20.72 12.71 67.39 90 | 96[0.12[0.6 | , , |
| 67.75 57.27 62.86 22.03 23.04 18.56 11.99 68.15 96 67.75 55.19 64.66 23.13 24.87 20.72 12.71 67.39 96 | 66.77 54.42 61.41 23.10 24.43 20.07 10.58 68.20 96 | |
| | 69.70 57.27 62.86 22.03 23.08 18.56 11.99 68.15 96 | |
| | | |

ı

| | • | • | 00 | 4 0 | 99 | 000 | 00 | 0 | • | | | | |
|---|------------|----------|---|------------|---------|--------------|--------------------|--------|--------|------|-----|--------|-----|
| 2 | | | | Γ | 200 | , | , | | 1 | | | | |
| 3 | | 2 | 9.0 | 6.73 | 4 - 6 2 | 8.93 8.03 | 13.00 | 8.74 | | | | | |
| 1 0 1 | | | 3.12 | 000 | • | 0 0 | 000 | 5045 | 14.22 | | | | |
| ACE STATION) | • | ; | : 00 70 • | 3.75 | | 89 | • | 6.32 | Ň | | | | |
| ER 15PACE | • 15 | , ' | | 3:5 | | 1.06 | 2.00 | 25. | • | | | | |
| TRANSF | *** | | 27. | ** | 27. | 8+·1 | • • | 200 | | | | | |
| COLLECTION/TRANSFER | | | 7.20 | 600 | 3.12 | 2.09 | - 00 - | 00 | | | | | |
| . 2 | ~ | • | 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : | .53 | 57. | 57. | 00.4 | 2.57 | • • | | | | |
| | | - | - | 1 | • | 01.1 | | 1 | | | | | |
| 7.5 | 104/22/751 | | 21 SI- | | 2 2 | | Ī | 5 | 04-001 | (ID) | | | |
| 17PE 17PE 17PE 17PE | 1 1 1 | , | 000 | 0 | 100 | 000 | 200 | 9 | | OF | POR | L' PAC | # P |
| F = | # # # X | - | 1785.0 | 220.00 | 1.0001 | | 200.2 | 623.00 | 00.001 | | | | 17 |
| ÷ ! ∪ | | | .00000 | 000-41 | 00000 | 9666 | • 60000 | 27.00 | 00000 | | | | |
| THERNAL PENALTY PORER PENALTY PORER PENALTY SELEC | | | POSER - 01 | | | : 3K3 | SAFETY Dev cost | - | RATING | | | | |

| | 3798 | 2013 | FOR EACH TON PARAN | FACH CONCEPT AFTER INC. PARAMETER RESENTING FLOOR 100 & MAK POINTS! | T AFTER EIGHTING FPOINTS | INCREASING 6 FACTOR BY- 51 | 3146 1 8Y 50 | | | |
|----------------------|---|-------------------------|-----------------------|---|--------------------------------|----------------------------------|-----------------|---------|---------|--|
| | f , , , , , , , , , , , , , , , , , , , | | | (| ' | i | | | | |
| | - | ~ | - | ¥ • • • | | • | - | - | • | |
| HORFAL | 70.01 | **** | \$2.00 | 27.75 | 20.46 | 22.00 | 14.22 | .7.41 | 61.40 | |
| | 70.06 | 51.02 | 22.64 | 30.37 | 21.63 | ~ | ~ | • | | |
| W1404 | -27.00 | -/2.00 | -22.45 | 20.02 | -20.96 | ~ | • | • | ż | |
| 35000 | | 53.77 | 53.65 | 27.11 | 20.29 | \$ 1 | s - | ? : | • | |
| THE CARE | 70.50 | 20.50 | 20.45 | 27.23 | 20.01 | 22.33 | *** | | : : | |
| - MAINTENC | | - 06.00 | 17.58- | 27.79 | - 50 - 16 | | | - | ÷ | |
| 246677 | 00.00 | 41.23 | 2.4 | 20.29 | 21.18 | \$ | 3 | 7 | ~ | |
| REC COST | 71.02 | 17:22 | -20.25 | 27.23 | 19:47 | -21175 24.23 | 13.23 | 66.79 | 90.27 | |
| | | | | | | | | | | |
| | | • | SENSITIV | 1 | ANALYSIS | | | | | |
| | 816LE | RATING FOR SELECTION | OR EACH | EACM-CONCEPT AFTER II | T AFTER | MCRE | ASING - | | | 3+4 |
| | | Sval | 1 0 0 0 | | RIDALX | | | | | |
| | - | ~ | | 2 0 7 | - S - | • | | | | |
| MORNAL | 10.01 | -46.54- | -62.00- | -27.75- | -50.46- | -52.66 | -14.22- | -14029- | | |
| THE SELECT | - 64.02 | 47,03 | 53.39. | 24.69 | 19.10 | 2 • 6 | 15.30 | 67.27 | ¥2.57 | |
| 12404 | 1601/ | | - 52 - 52 - | 74.45 | 70.06 | | • • | - 7 | • • | |
| THERMAL | | *0.0* | \$1.05 | 20.05 | 20.48 | ; | | | • | |
| | | -45.64- | -24-16 | -26.92 | -20.54 | -23047 | 13.44 | -0000 | 71.79 | |
| MAINTENC - CAFFTY | 71.60 | -50.50 | -53.06- | -27-17- | -14.01- | 0 - 7 - 7 | | - 15:57 | : : | |
| DEV COST | 70.20 | 46.70 | *0.* | 26.37 | - | 7 | - | • | • | |
| | | -62017- | -57.20 | 52.55- | 51.403 | ?: | -12:43- | | ÷ | A THE PARTY AND THE PARTY OF TH |

CRITICAL

ITEMS

SAFETY

NUMBER

ir.

APPLIANCE CUNCEFT COMPONENT SUMMARY MATRIX

z w **ACCUMULATOR** 2 0 **ЯЗТА**ЗН ۵. X 0 **ROTO!** U ~ ~ ~ ANNUAL S ~ 0 F COLTROLLER TIMER **...** œ qMUq 8 FF APPLIPICE FUNCTION: 2.1.1-FECAL COLLECTION/TRANSFER X - ורבנצ m ~ ~ RECULATOR m 3 CHECK ~ --~ AZWO.19 ~ SOLENOID 21 5 7 9 COMPON_NT TYPE INTEGRATED VACUUM DECOMPOSITION O NO ANAL WASH FLUSH FLOW CXYGEN INCTNERATION O NO ANAL WASH PYROLYSIS/BATCH INCINERATION o NO ANAL KASH VACUUM DRY
O NO ANAL HASH
O NONYENTED GERMICIDE O MO ANAL MACH WPLIANCE TYPE VACUUM DRY
C AMAL WASH
O NOWVENTED

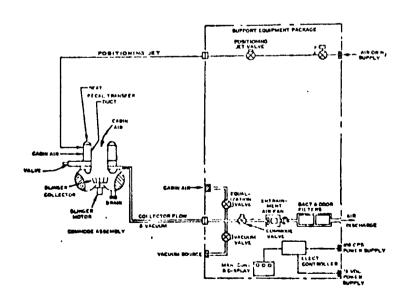
27

WET DXIDATION O NO A..AL WASH SEMIAUTOMATIC BAG SYSTEM (SKYLAB)
O NO AJAL WASH

DRY BAGS

| SPACECRAF | T Space Station | | |
|-----------|----------------------|----------------------------------|-------------------------------|
| HABITABIL | ITY SUBSYSTEM Person | al Hygiene HABITABILITY FUNCTION | Waste Collection, Transfer |
| APPLIANCE | FUNCTION Fecal Coll | ection/Transfer | |
| APPLIANCE | CONCEPT NO./TITLE | 1/Dry John | |
| INDEX NO | 2.1.1.1 | REF. NO. 207,209,250 | , & 273 |

DESCRIPTION The dry john commode assembly serves as a waste collector and feces storage/processing unit. The seat is similar to the terrestrial type with modifications necessary for zero-gravity usage. The feces are transferred to the storage/processing section (collector) via the fecal transfer duct. The fecal transfer duct contains provisions for entrainment airflow for separating and moving the stool from the anus to the collector. Air positioning jets shown on the schematic are used to assist the user in positioning properly On the seat. This portion of the system was not considered part of the appliance, since recent tests have shown the jets are not necessary. The interface between the transfer duct and the feces collector is the collector valve. The valve is manually actuated and seals the collector after use to permit vacuum drying of the feces. A sunger is incorporated to maximize the feces and wipes area exposed to vacuum by depositing the feces and wipes on the wall of the collector. Entrainment air and air removed by the vacuum pump are passed through filters and returned to the cabin. The schematic does not show a vacuum pump; however, the vacuum pump was added to the appliance concept to satisfy the vehicle requirement of no venting external to the spacecraft.



As a second seco

| CONCEPT_I/DEY JOHN | APPL1AN | ICE CONCEPT | REQUIRE | MENTS AND | PENALTIES CALC | ULATIONS INDEX | NUMBER 2.1 | 1.1. |
|-----------------------|-------------|---------------|---------------|---|-----------------|---------------------|-------------|--|
| | ELECI | RISAL | <u>P 0</u> | WER | REQUIRE | MENIS | | |
| | • | | A C | POWE | R | 0 | C POWE | |
| | USE TIME | 2 | | 3 | (4) Demānd | (5) | 6 | (7) Demand |
| | CYCLE | PEAK | | AVERAGE | (WATT-HR/ | PEAK | AVERAGE | (WATT-HR |
| COMPONENT (REF) | (HR) | (WATTS | | (WATTS) | CYCLF) ① X ③ | (WATTS) | (WATTS) | CYCLE) |
| • | | | | | | (#6115) | (#///// | Φ ^ Φ |
| COMMONICATION (201) | 10 | _75 | | 60 | _6 | | | |
| AIR FAN (209) | | 250 | | 180_ | _18 | | | |
| VACUUM HAIP (209) | .05 | 350 | <u></u> | 200 | _10 | | | |
| SOLENOLD VALYLY (209) | | RY | | | | _32_ | 32 | <u> </u> |
| CONTROLLER/METE (201) | 115 | | | . === | | 30 | _20_ | _3,0 |
| | | | <u> </u> | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | _ | | | | • | • |
| | | 673 | 5 | | <u>34</u> | 62 | | _3.0 |
| | | MAXIMU | ч ' | | TOTAL | MAXINUM | | . TOTAL |
| | | * | • | • | | | • | • |
| • | | | | | | | | |
| • | | | | | | | | |
| | | | | • | | • | • | |
| | | <u> </u> | <u>AL.</u> | <u>s</u> e q u 1 ! | REMENIS | | | |
| • | | | | | ••• | | | |
| • | | LATENT | | SEN | | HEAT LEAK | | COOLANT |
| SOURCE | | (BTU/HR |) | (BT | U/HR) | (BTU/HR) | (| BTU/HR) |
| | | | • ' | | | 4 | | |
| BUNKER MOTOR | | | | | <u> </u> | 103.3 | | |
| AIR FAN | | | | 34 | 4/ | 341,0 |) | |
| VACUUM PUMP | | | | | 38.7 | 238.7 | | |
| VACOON POMP | ···· | | | <u>ac c</u> | 2011 | 200, | | |
| | | | | | | · | | |
| | | | | | | | | |
| | | | | | | | | |
| | TOTAL | | • | 200.3 | (683) | 200.3 (68 | 3) | |
| ' | IUINL . | MATT (BTU) | (un) | | | • | - | |
| | | MALI (BIU) | mn) | WALL | (BTU/HR) | WATT (BTU/HR |) WAL | T (BTU/HR) |
| | | • | | | | . • | | |
| • | | • | | | • | | | |
| , | | | | | • | | | |
| | • | | | | | 44 | | · |
| . ' . | i | | | • | | | | |
| | . 0 | PERAT | 1 0 N A | L PE | NALTIES | | • • | • |
| | | | | | | | | |
| •• | EXPE | I-DABLE | THE | RMAL | ELECTRICAL | WEIGH | τ . | VOLUME |
| SOURCE | | CYCLE) | | CYCLE) | (PK WATTS/CYC | | | (NOISSIN/s |
| • | (40) | . • | (5.5) | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | (1) (1) (1) | ,22, (20,00 | , | ,, |
| N/A | • | | | | | . • | | • |
| | | •. | , | | | | | |
| | | . | | | | | | |
| · | | | | | | | | |
| | | | | | | | | |
| \ | | | | | | | | · |
| 1 | | | , | . | | | | ······································ |
| | | | | | | | | |
| . 10 | TAL | , | | | | | | |
| | KG/ | CYCLE | WATTS | CYCLE | | KG/MISS (LB/MISS | ION M3 | MISSION) |
| • | (LD/ | CYCLE) | (RIA\H | R/CYCLE) | • | (FB/W122 | tou) (FI | Au122104) |

is

| CONCEPT ///27/JOHN | | REQUIREMENTS AND PEN | VELLEZ CYFCOFALI | INDEX NUMBI | R 201.1.1 |
|-----------------------|-----------------------|---------------------------------------|------------------------|--|--|
| | <u>EIXED WE</u> | T B H 1/A O F n W E | <u> </u> | EMENTS | |
| COMPONENT | (REF) | | IGHT LBS) | | VOLUME (FT ³) |
| Commove Common | | | 37 | | 3.0 |
| PIKKIGING | (202) | | 25 | | 26.2 |
| VACUUM PUMP | (207) | | 38.1 | | <u> </u> |
| WIPUS | | <u> </u> | 20.1 | · · · · · · · · · · · · · · · · · · · | 7:60 |
| | | | • | | , |
| | | | | · | |
| | | | | • | |
| | | | | | |
| | | , | | | |
| | TOTAL | 144. | 2 (318.1) | .9 | 5 (33.7) |
| , | | , | (LBS) | المستعندة. | M ³ (FT ³) - |
| • | | • | | • | • |
| <u>s o L</u> | <u>ID</u> <u>EXPE</u> | NDABLE WI | _ | UIREMENIS | |
| | • | WT/UNIT (REF) | ③ WT/CYCLE | . VOL/UNIT (REF) | VOĽ∖CÅČTE O |
| TYPE UNIT | ① (F S/CYCLE(REF) | PKG.WT/UNIT)(REF) (LB) | ①x② (LB) | (PKG.VOL/UNIT)(REF (FT ³) |) ① X ④ (FT³) |
| DRY WITES | | 2.09/126 (250) | .0312 | .129/196 (250 | |
| WET WIPES | | 3.4/70 (250) | .0486 | , | .00184 |
| WITES | <u> </u> | | | | |
| And the Oat Annual Co | 1/1104 | | 026 | 73.7 |) 01215 |
| COMMODE COLLEGE | <i>1/1104</i> | 40 (201) | .0351 | | 1.01.315 |
| | | | | | |
| | | | 1110 | 76 | .016965 |
| | | Σ3 _ | 1149 TOTAL WI/CYCLE | Z @ | TOTAL VOL/CYCLE |
| *AT#1 1/7 | | | (LB) | | (FT ³) |
| TOTAL KT. MISSION 6 | x <u>18</u> | 4 x/ | 149 | 5 | 7,5 (126.8) KG (LB) |
| CYCLES/DAY | DAYS | MISSION TO | T.WT/CYCLE (LB) | | KG (LB) |
| TOTAL VOL . | . 16 | · a | 16965 | . 5 | 29 (18.7) |
| CYCLES/DAY | DAYS, | PA x | T.VOL/CYCLE | <u></u> | 29 (18.7) H ¹ (F1 ¹) |
| • | | | (FT3) | | |
| | | | | | |
| <u>6</u> <u>4</u> | <u> </u> | EXPENDABL | ES REQU | IREMENTS | |
| | 0 | (| ② · | T.RECOVERED/CYCLE | AMT LOST/CYCLE |
| | AMT.USED/CYCI | LE(REF) . RECO | 745111 | (LB) | (1) - (3) |
| TYPE | , (LB) | FAC | CTOR . | (LB) | _(re)_ |
| | - i - | | | | |
| | | | | * | |
| | | | | | |
| | | | | | |
| | | · · · · · · · · · · · · · · · · · · · | | | |
| Σ | ① | | | Σ \odot | |
| 3 | | , | • | | |
| TOTAL NT. | X | x | | • | |
| CYCLE/DAY | TUAYS7MISE I | ONT 1077ET 0517CY (2 (3) | (LB) | (2 (1) | KG (LB) |

D2-48561-4

| SPACECRAFT Space Station |
|--|
| Waste Collection HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer |
| APPLIANCE FUNCTION Fecal Collection/Transfer |
| APPLIANCE CONCEPT NO./TITLE 2/Dry John with Anal Wash |
| INDEX NO. 2.1.1.2 REF. NO. 207,209, & 273 |
| DESCRIPTION Same as Concept 1, Dry John, with the incorporation of an anal wash. The anal wash and air dry eliminates the need for expendable wipes. The addition of the anal wash requires the feces collector duct be rinsed with a biocide. The anal wash and commode rinse water are assumed to be recovered within the efficiencies of the vapor compression distillation unit. |

APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS CONCEPT 2/185 JCHN/NNIC WISH

y/5

INDEX NUMBER 21.1.2

| | ELEC | IRICAL | POWER | REQUIRE | MENTS | | |
|---|-------------|---|-----------------|---|--|-----------|------------------|
| | M | A_(| C POWE | R | n_c | POWE | _R |
| | USE TIME | 2 | 3 | (4) DEMAND (WATT-HR/ | (3) | 6 | DEM |
| | CYCLE | PEAK | AVERAGE | CYCLE) ① X ③ | PEAK | AVERAGE | (WATT |
| OMPONENT (REF) | (HR) | (WATTS) | (WATTS) | | (WATTS) | (WATTS) | ① x |
| SUNSUR 19071 (209) | | <u>80</u> | 60 | 10.02 | | | |
| UK HENCER (209) OLNOIO VILVEXXXX | | | | | 350 40 | 300 | _15 |
| UKFIIN (201) | | 250 | 180 | 30.06 | <u> </u> | 70 | , == |
| COMINICA LEPZITUMENC | | , | | | 30 | 20 | 4 |
| ACUUM PUMP (20) | | 350 | 200 | 10 | | | |
| | | | | | <u></u> | | |
| | | | | | | | . |
| | | 680 | • | 50.1 | 420 | • | 19. |
| | | MAXIMUM * | | TOTAL | MAXIMUM | | . 101 |
| • | | , | • | | • | | • |
| | | | | | | | • |
| • | • | | • | | | • | - |
| | | * | | | • | | |
| | | IHERMAL. | 7 7 7 7 7 | REMENIS | | | • |
| | | LATENT | SEN | SIBLE | HEAT LEAK | 10 | COOLANT |
| SOURCE | | (BTU/HR) | (BT | U/HR) | (BTU/HR) | (| BTU/HR) |
| HENTED WATER | | - | | 94 | 394 | | |
| HETTER AIR | | <u> </u> | | 38 | 238 | | _ |
| | | | | | | | |
| | | | İ | 31.4 | 181.4 | | - |
| MINATE MOTOR | | | | 31.4 676 | 181.4 | | |
| SUNGER MOTOR ALL FAN | | | _5 | 67.6 | 567.6 | | |
| SUNAER MOTOR ALL FAIL VACUUM PUMP | <u> </u> | | _5 | | | | |
| SUNGER MOTOR ALL FAN | | | 5 | 67.6 38.4 | 567.6 | | |
| ALKAER MOTOR | TOTAL | MATT (BTU/HR) | _5 _2 474 | 67.6 | 567.6 238.4 | .(4) | |
| ALKAER MOTOR | | MATT (BTU/HR) | _5 _2 474 | 67.6 38.4 (1619.4) | 567.6 238.4 474 (1619 | .(4) | T (8TU/HI |
| ANAFR MOTOR | | MATT (BTU/HR) | _5 _2 474 | 67.6 38.4 (1619.4) | 567.6 238.4 474 (1619 | .(4) | T (8TU/HI |
| ANAFR MOTOR | | WATT (BTU/HR) | _5 _2 474 | 67.6 38.4 (1619.4) | 567.6 238.4 474 (1619 | .(4) | r (8TU/HI |
| SUNGER MOTOR ALL FAN | | WATT (BTU/HR) | _5 _2 474 | 67.6 38.4 (1619.4) | 567.6 238.4 474 (1619 | .4) | r (BTU/HI |
| SUNGER MOTOR ALL FAN | TOTAL | • | | 67.6 38.4 ((419.4) (BTU/HR) | 567.6 238.4 474 (1619 NATT (BTU/HR) | .4) | T (8TU/HII |
| BUNGER MOTOR BUL FANL | TOTAL | MATT (BTU/HR) | | 67.6 38.4 (1619.4) | 567.6 238.4 474 (1619 NATT (BTU/HR) | .4) | (BTU/HI |
| BUNGER MOTOR BUL FANL | TOTAL | OPERALION | | 67.6 38.4 ((419.4) (BTU/HR) | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT! | r (BTU/HI |
| BUNGER MOTOR BUL FANL | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | • . • VOLUME |
| SUNAER MOTOR ALL FAIL VACUUM DUMP | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) NALIIES ELECTRICAL | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | VOLUME |
| SUNAER MOTOR ALL FAIL VACUUM PUMP | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) NALIIES ELECTRICAL | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | • . • VOLUME |
| SUNAER MOTOR ALL FAIL VACUUM DUMP | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) NALIIES ELECTRICAL | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | • VOLUME |
| SUNAER MOTOR ALL FAIL VACUUM PUMP | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) NALIIES ELECTRICAL | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | VOLUME */MISSION |
| SUNAER MOTOR ALL FAIL VACUUM DUMP | TOTAL | OPERAIION | | 67.6 38.4 ((6/9.4) (BTU/HR) NALIIES ELECTRICAL | 567.6 238.4 474 (1619 NATT (BTU/HR) | (.4) HAT | VOLUME |

KG/MISSION (LB/MISSION) (L13/MI2210N)

WATTS/CYCLE (BTU/HR/CYCLE)

TOTAL

KG/CYCLE)

S

CONCEPT 2/DRY TOUN MAN WASAF

| | <u>E I X E D</u> | WEIGHI | AN OF NWE B | EQUIBEME | <u>N</u> J S | |
|------------------------------------|-----------------------------|-------------------------------|---|------------------------|---|--|
| PACKAGIMO | Campunous (201 | 2.09) _ (209) _ | WEIGHT (LES) 11.5 10.5 16.8 12.8 | | | VOLUME (FT ³) 4 26 15 |
| | TOTAL SOLID EXP | ENDAB | . 234 (57 . KG (LBS) LE N.T/VOL | (C) REQUIR | | 159 (56) N ³ (ft³) |
| N/A TYPE | UNITS/CYCLE(REF) | WT/UNIT (PKG. WT/UN (LB | (17)(REF) $(1)x($ | CLE . VO | (FT ³) | (E) (A) (E) (A) (A) (A) (A) (A) (A) (A) (A) (A) (A |
| TOTAL VOL | CYCLES/DAY X DA | YS/M15S10N | ∑3 | 3) - | Σ. | TOTAL VOLTCYCLE (FT') KG (LB) |
| MISSION | <u>6 A S/L 1 Q U 1 D</u> | YS/MISSION . <u>E X P</u> | 0 | <u>R E Q U 1 R E !</u> | MENIS O FFED/CYCLE | M3 (FIT) AMT LOST/CYCLE |
| TYPE WATER (ANA) WATER (COMM | | (207) | RECOVERY FACTOR (1-,0009) (1-,0009) | | (A) (B) (A) (A) (B) (B) (B) (B) (B) (B) (B) (B) (B) (B | 0-3 (LB) .00148 .00148 |
| TOTAL MT MISSION - CYC | Σ ① _3.30 Δ × _ DAYS/HIS | ، در الم | .00297 TAL TOST/CYCLE | <i>3.279</i> + | | 2.98 (6.58) |

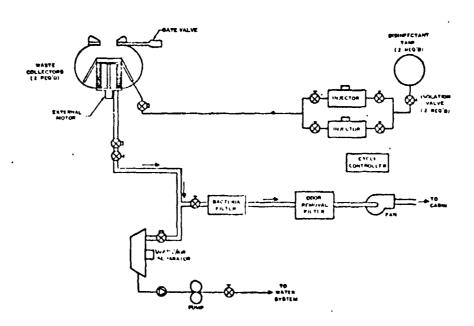
SPACECRAFT Space Station Waste Collection/
HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer

APPLIANCE FUNCTION Fecal Collection/Transfer

APPLIANCE CONCEPT NO./TITLE 3/Liquid Germicide

INDEX NO. 2.1.1.3 REF. NO. 100,207,209,244,250, & 273

DESCRIPTION The liquid germicide commode assembly incorporates a strong biocidal agent throughout the excreta to kill the microorganism population and maintain sterility in storage. The waste collector is provided with a blender and germicidal metering equipment. The blender is used to ensure thorough mixing of the wastes and germicide. The collector gate valve is open only during waste collection. When the container is full, the tank is sealed, removed to storage, and replaced with an empty tank. The waste collectors are sized for replacement every 50 days. Some liquid is recovered, separated, and returned to the water waste management system. Air entrainment of the feces as previously described in Concept 1, is utilized with the air returned through filters to the cabin. The collector when transferred to storage will weigh 332 pounds. Wet and dry wipes are used for this concept and are assumed to be deposited into the collector. The concept was not given credit for liquid recovery, since the majority of the liquid is held in the collector.



D2:1135(4-4

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT 3/4/4/10 GERRICIUC INDEX NUMBER 2 1.1.3 ELECTRICAL POWER REQUIREMENTS POIER POWER (7) DEMAND DEMAND 0 3 (3) **6** (WATT-HR/ (WATT-HR/ CYCLE PEAK **AVE** RAGE PEAK AVERAGE (Dx() (DX) COMPONENT (REF) (HR) (WATTS) (WATTS) (WATTS) (WATTS) BLINKY 1911(1(R (100,20)) .05 150 5 100. .158 SXLNOIDVALVE (2) OUR FAIN ASSEMBLY 250 180 28.4 CONTROLLER/IIMUR 158 30 20 400 33.4 46 3.2 MUMIXAM TOTAL MAXIMUM TOTAL THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COOLANT SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) MA BLUNIX-R MOTOR 102.3 102.3 AIR FAN ASSEMBLY NHA 188.3(642.2) TOTAL MATT (ETU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) OPERATIONAL PENALTIES THERMAL ELECTRICAL VOLUME WEIGHT HEAT LEAK TO COOLANT SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK HATTS/CYCLE) (LB/MISSION) (FT3/MISSION)

KG/MISSION

(LB/HISSION)

MIMISTING (FTI/MISSION)

HATTS/CYCLE

(BTU/HR/CYCLE)

TOTAL

WATTS/CYCLE

(BTU/HR/CYCLE)

15

APPLIANCE CONCEPT REQUIREMENTS AND FERMITIES CALCULATIONS (CONCLUDED)

CONCEPT 3/4.190110 CARTUICADO:

INDEX NUMBER 2.1.1.2

| COMPONENT LIG GLPMICA WCT/DZY W | (KE) OL SYS. (100, 2 NYOS (250) | 44) | WEIGHT (LBS) 840 28. 1 | | - | VOLUME (FT3) 71. 4.2 |
|--|---------------------------------------|------------------------|--|--------------------------------|---|---|
| | | | | | | |
| | TOTAL | | 420.9 (9. | 28.1) | · | 3 (75.2) 1 ³ (11 ³) |
| TYPE DRY WIFES WET WIPES COLLLICTOR | SOLID EXI | 34/70 | E) MI/CA M I/A 0 F | CLE VOL (PKG.) | MENTS /UNIT (PEF) VOL/UNIT) (REF) (FT3) 29/116 (25) | (5) VOL/CYCLE (D) x (4) (FT 3) 0 _ 001975 |
| OTAL WT. | LES/OAY D | 184 Ys/Mission | 101.WT/CYC ((B) |) | | 10165 TOTAL VOL/CYCLE (FT2) |
| TOTAL YOL THE MISSION TOTAL | LESZDAY DE | 184 Ys/Mission — | x | CTE | .52 | (18.2) _ (13) |
| TYPE LIGUID GLEU | G A S/L 1 Q U 1 C AMT. USED/C (1) | D YCLE(REF) , B) | DABLES RECOVERY FACTOR | REQUIREM AMT.RECOVE () X (L | 3 FED/CYCLE | MT LOST/CYCLE (1)-(1) (18)6.15 |
| | Σ0 .6/3 | <u> </u> | * | | Σ : | .615 |

SPACECRAFT Space Station

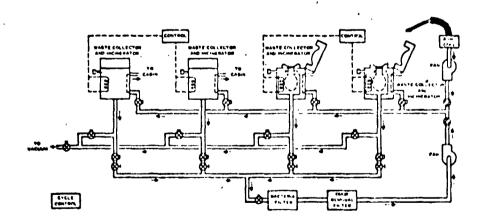
Waste Collection/
HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer

APPLIANCE FUNCTION Fecal Collection/Transfer

APPLIANCE CONCEPT NO./TITLE 4/Integrated Vacuum Decomposition

INDEX NO. 2.1.1.4 REF. NO. 100,250, & Skylab data

DESCRIPTION The integrated vacuum decomposition concept utilizes vacuum and high temperature to decompose the waste materials into gaseous products which can be exhausted to vacuum. The chamber requires cooldown and must be vacuumed at the end of the cooldown period. The process does not require oxygen; however, requires power to sustain the chemical process for 12 hours. Six commodes were assumed to be required due to the 12-hour cooldown time (i.e., one unit can be used once per day). Incinerable collection bags with a hydrophobic patch (Skylab type utilized) were used to eliminate the maintenance and microbiological problems of filter replacement since clogging is not anticipated with collection bags which are replaced every 24 hours. The residual ash was not considered as a concept penalty. Air entrainment of the feces, as previously described in Concept 1, is utilized with the air returned through filters to the cabin. Wet and dry wipes are used for this concept and are assumed to be deposited into the collector.



()

4/5

INDEX NUMBER Z. 1. 1.

| | <u>IRICAL</u> <u>P</u> | POWE | <i>></i> . | D | C POW | F D |
|--|--|-----------------------|--|----------------|-------------------------|----------------|
| USE TIME CYCLE CON. CONF'IT (REF) (HR) | PEAK | 3 AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ①X(3) | ⑤ PEAK (WATTS) | 6 AVERAGE (WATTS) | CYCLE) |
| AIR FAH ASSE (100) | 500 | 360 | 36_ | | | |
| DOLCHOLD JACVIS(7) MOMONIA | | | | 56 | _56_ | - |
| MC. SOLEN YALVIS(1) | | | | 56 | 56 | 1200 |
| HENTER 12 CONTROLLERISIONER 24 | - | | | 1000 30 | 1000 20 | · 1200 480 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| , | 500 MAXIMUM | • | 36 TOTAL | | • | 12980 101AL |
| •. | .* | • | | | • | • |
| | • | • | | • | | • |
| | | • | | • | • | • |
| | IMERMAL. | REQUI | REMENTS | | • | • |
| • | LATENT | | SIBLE | HEAT LEAK | | COOLANT |
| § SOURCE | (BTU/HR) | (BT | U/HR) | (BTU/HR) | | (BTU/HR) |
| FAN ASSY | | | 710 | _1710 | | |
| HEATERS | | -25 | 10 | 3410 | | - |
| | | | | | - | |
| | | | | | | |
| | | | | | · · · | |
| TOTAL | • | 1499 | (5120) | 1499 (512 | そ っ) | |
| IUIAL | WATT (BTU/HR) | WATT (| (ATU/HR) | MATT (BTU/HR | - | T (BTU/HR) |
| | | | | | , | , (0.0),,,, |
| • | • | | | • | • | |
| | · | | | | | |
| | • | | • | • | | - |
| | OPERATION | AL LE | NALIIE | <u>s</u> | | • |
| | | COOLANT /HR/CYCLE) | ELECTRICA (PK HATTS/C | | - | , NOT GWE |
| N/A — | ······································ | • | | | | • |
| | | | | | • | |
| | | • | | | | |
| • | | | | | | |
| | | | · | | | |

C2-155

L'ATTS/CYCLE (BTU/HR/LYCLE) KG/MISSION (LB/MISSION)

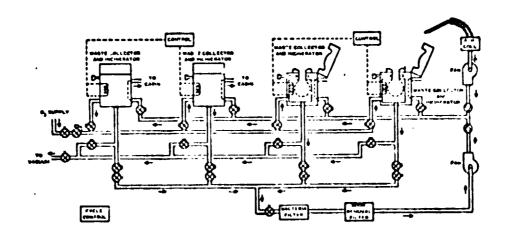
(N) (15510N (FT ') (N) (N)

WATTS/CYCLE (BTU/HM/CYCLE)

| CONCEPT 4/JNICOPATE | APPLIANCE CONCEPT RE Q VACUUM DE | QUIPEMENTS AND FERALTIES (COMPPOS 1710N | CALCULATIONS (CONCLUI | 010) NDEX NOMBER <i>2.1.1.11.</i> |
|---|---|--|---|---|
| COMPONENT COMMODE 11554 WET/DRY WIPE | (REF) | GHT/VOLUME RI WEIGHT (LBS) 354(\$\frac{3}{2} - 5 | EQUIPEMENIS | volume (f1) 127(4) = 190 4.2 |
| | | | | |
| * INCLUDES THEFTAL | TOTAL . | 28.0.4 (C | (18.1) | 5.51 (194.2) |
| | D (PKG TS/CYCLE(REF) 3 (250) 2.0 1 (250) 3.0 | MINIT (DEE) WILL | 3) YCI E VOL/UN1 (PKG. VOL/) B) (FT 1/2 1/29// | UNİT)(REF) ①X④ |
| TOTAL WT. WISSION CYCLES/DA TOTAL VOL. MISSION LYCLES/DA | x18 | \$\$\frac{30}{10TAL w}\$ \[\begin{array}{cccc} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | ·• [| Σ • 0/06 101AL VUI/CYCLE (F1') 154.7 (LB) (340.9) |
| | | (FT ³) | MEQUIREMEN AMT. RECOVERED () (LB) | • |
| TOTAL NT. NISSION CYCLETODAY | ① | 101A TOUT/CICLE | (Lb) bx (| Σ |

SPACECRAFT Space Station. Waste Collection/ HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfor APPLIANCE FUNCTION Fecal Collection/Transfer APPLIANCE CONCEPT NO./TITLE 5/Flush Flow Oxygen Incineration REF. NO. 100,250, & Skylab data INDEX NO. 2.1.1.5 DESCRIPTION The flush flow oxygen incineration utilizes a continuous oxygen flow to the collection chamber for the 12 hours required for incineration. The wastes are collected by some process of air entrainment used on the previous concepts, sealed in the chamber (no vent to vacuum), heat is applied for a specified time period. The resulting sterilized/vaporized gas and vapors are exhausted to space. The valve is left open and heat is applied to bring the incineration temperature to 1000°F, while a controlled flow of oxygen is continuously supplied to the chamber. The incineration process takes approximately 12 hours with 97 to 99 percent reduction in process waste. Twelve hours are allowed for cooldown which requires one commode per man. The collection bags described in Concept 4 are also used for this concept. Wet and dry vipes are used for this concept and are assumed to be deposited into

the collector.



APPLIANCE CONCEPT REQUIPERINGS AND PENALTIES CALCULATIONS CONCEPT S//LUST FLOW OXYGUN INCINCINION

0/5

INDLY NUMBER 2.1.1.

| E L | ELECTRICAL POWER REQUIREMENTS | | | | | |
|--|-------------------------------|---------------------------------------|---|---|--|--|
| | A C | D C | DC POWER_ | | | |
| USE) CYCL COMPONENT (PEF) (HR | E PEAK . | DEPAND AVERAGE (WATT-HP/ CYCLE) | | (6) DEMAND FERAGE (WATT-HR CYCLE) FATIS) (DX(7) | | |
| | 500 | (HATTS) (D.2) 360 4320 | (ATTS) (H | IATIS) ①x⑦ | | |
| EXENCID VALVES(7) MEMORI VACUUM VALVES(1) 12 HEATER 12 | incy | <u> </u> | | 56 - 56 - 00 · 6 xx | | |
| ONTROLLER TIME 24 | Mary | | _56_ _30 | 56 <u>-</u> 20 <u>480</u> | | |
| | 500 | 4320 TOTAL | 698 MAX MUM | . 648C | | |
| ٠, | • | | • | • | | |
| | LATENT | REQUIREMENTS SENSIBLE | HEAT LEAK | TO COOLANT | | |
| y SOURCE | (BTU/HR) | (BTU/HR) | (BTU/HR) | (BTU/HR) | | |
| AIRFAU MOTOR HENTURS | N/A _N/A | _1705 _2380 | <u> 1705 </u> | N/A N/A | | |
| HERICKS | | | • | | | |
| | | | | | | |
| TOTAL . | MATT (CTU/HR) | 1198 (4035) NATT (BTU/HR) | 1 <u>198 (4085)</u> Watt (BTU/HR) | WAT. (BTU/HR) | | |
| • | • | | *, . | | | |
| · . • . | <u> Perailona</u> | L ZENALILE | <u>.</u> <u>.</u> | • | | |
| , SOURCE (BT | | OOLANT ELECTRICA R/CYCLE) (PK WATNS/C | | 'VOLUME (F1 ³ /M15510H) | | |
| - N/A - | | | • | <u>.</u> | | |
| | | | | | | |
| | | | | - | | |

AU/MISSION (LB/MISSION) M'/MISSION (FT)/RISSION

WATTS/CYCLE (BTU/HY/CYCLE)

TOTAL

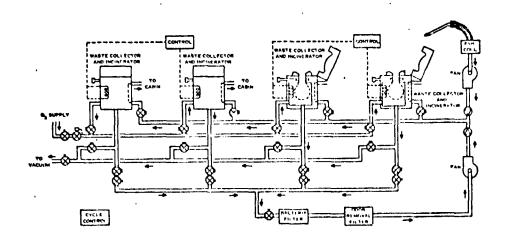
WATTS/CYCLE (BTU/H?/CYCLE) APPLIANCE CONCEPT REQUIREMENTS AND PENALTITS CALCULATIONS. (CONCLUDED)

CONCEPT 5/17 WILLIAM CAYGON IMPINER/TION

INDEX NUMBER 2.1.1."

| <u>F</u> | TXED M | EIGHT/V O | LUME R | <u>EQUIREME</u> | H I S | |
|---|-------------------------|---|--|------------------------------|----------------------|--|
| COMPONENT COMMICUL ASSY, M WET/DRY (VIPUS | (ker) (100) (250) | 37 2 ₍ | WEIGHT (LBS) (L)=559 88 | | 123(4) = | VOLUME (FT ³) 18:4 4, Z |
| | | | | | | , |
| | | | | | | |
| | TOTAL | 2 | 43.5 (64 KG (LBS) | 47.1) | 5.3 | Z (188.Z) |
| * INCLUDES WEIGHT | | | BAGS | P.S.O. 1. P.S | • | |
| | O (I | NDABLE WT/UNIT (REF) PKG. WT/UNIT)(F (LB) 0.04/19(.() | ₹EF) ÛX((LE | B) VCLE VOL (PKG. B) | | © VOL/CYCLE () X (4) (FT?) -00/975 |
| LOLLETION BASS 1 | _(100) | 229 (sk) | -22° | 1 | • | 0.0068 |
| OTAL WT. CYCLES/DAY | x / E | . Σ 34 x MISSION X | 309 TUTAL HT (LB .309 TOT.WI/CYC (LB) | 3) • | Σ⑤ [/54.9] | .0106 TOTAL VOL/CYCLE (FT1) (340.9) G (Lb) |
| MISSION CYCLES/DAY | x 18 | MISSION X | -0106 TOT. VOL. /CY (FT 3) | CLE | .33 H | 1 (11.7) 1 (11.1) |
| | | | · · · · · · | | | • |
| TYPE | AMT. USED/CYCL | | ABLES RECOVERY FACTOR N/A | REQUIREM AMT.RECOVE OX (L | 3) RED/CYCLE ② | ## LOST/C/CLE |
| į. | .428 | 3 | | | ΣΦ | .428 |
| PISSION CYCLL/DAY | x - 184 DAYS/115510 | N TOTAL T | OST/CYCL E | 72.5 | L. | 14.5 (4729) KG (LB) |
| | | (2 | (4) | (LB) | ራ ጠ | |

SPACECRAFT Space Station Waste Collection/ HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer APPLIANCE FUNCTION Fecal Collection/Transfer APPLIANCE CONCEPT NO./TITLE 6/Pyrolysis/Batch Incineration INDEX NO. 2.1.1.6 REF. NO. 100,250, & Skylab data DESCRIPTION The pyrolysis/batch incineration concept utilizes a three-step process to minimize oxygen consumables. The wastes are heated to 2500F and held at this temperature for 30 minutes to ensure sterilization. The vent valve is then opened and the water is flashed to space as a vapor. The chamber is then heated to 1200°F, with the vacuum valve remaining open, and the wastes are pyrolytically decomposed (vacuum decomposition) and the gases are vented to ,pace. At the end of the pyrolysis process, the vent valve is closed, the chamber is charged with oxygen, and several batch incinerations are performed. The batch incineration step reduces the ash residue from 12 to 2 percent of t e total wastes processed. After final venting to space, the chamber cooldown takes 12 hours. The pyrolysis/batch incineration process is identical to the schematic shown for Concept 5. The pyrolysis/batch incineration takes 12 hours. The collection tags described in Concept 4 are also used for this concept. Wet and dry wipes are used for this concept and are assumed to be deposited into the collector.



APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS CONCEPT 6 12420LSSS 1811CH INCINE 12011CM

1/5

INDEX NUMBER Z.1.1.

| witter 1017 720010131011 | | | | | NUMBER COPPER |
|---|---------------------------------------|--------------------------------------|---|--|--|
| | ELECTRICA | | REQUIR WER | EMENIS DO | POWER |
| COMPONENT (REF) | SE TIME (2 CYCLE PEA (HR) (WATT |) ③ K AVERAGE S) (WATTS | (4) DEMAND (WAT1-HK/ CYCLL)) (1) X (3) | ⑤ PEAK (WATTS) | 6 DEMAR AVEPAGE (WATT-R CYCLE (WATTS) (D.X.C) |
| SOLUTOID VILLY(S(1) MOD VACUUM UPLY(TS(1) Oz VALVLS (7) | 12 50 newiner = " = | O 360 - = = = | <u>4.320</u> | . <u>56</u> 56 56 | 56 - 56 - |
| | 2 <u>-</u> 94 <u>-</u> | | | 30 | 1000 1200 20 48 |
| | 500 Maxim | | 4320 TOTAL | 1198 MAXIMUM | 1 <u>246</u> TOTAL |
| ٠, | | • | | | |
| | <u> </u> | AL REQU | <u>.</u> J <u>lrement</u> s | <u>,</u> | : |
| . SOURCE | LATEN' (BTU/H | | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
| AIR FAN MOTOR | N/A | | 1705 | _1705 | _ N/A_ |
| 4ENTER | <i>\!\!</i> | | 3410 | 3410 | N/A |
| | | | | | |
| TOTA | L WATT (BTU | - 150 1/HR) WA | 00 (5115) htt (Btu/HR) | 1500 (511 WATT (BTU/HR) | • |
| • | | | | • | |
| | <u> </u> | <u>[10 n a l</u> | <u>PENALTIE</u> | <u>. </u> | |
| SOURCE | THE HEAT LEAK (BTU/HR/CYCLE) | ERMAL TO COOLANT (BTU/HR/CYCLE | ELECTRICA (PK WATTS/C | | |
| <i>N/A-</i> | | | | • | |
| | , | • | | | |
| | | | | | |

C2-161

(FP/WISSION)

MYMISSION (FTYMISSION)

WATTS/CYCLE (BTU/HR/CYCLE)

TOTAL

WATTS/CYCLE (B' J/HR/CYCLE)

APPLIANCE CONCEPT REQUIPEMENTS AND FEMALTIES CALCULATIONS (CONCLUDED)

| CONCEPT GPROLYSISTBATCH INCINENTION | INDEX NUMBER Zolel C |
|-------------------------------------|----------------------|
| | |

| <u>F</u> 1 | XED HET | CHIVY OF THE BE | QUIREMENTS | |
|---------------------|------------------|--|---|---|
| COMPONENT | (REF) | WEIGHT (LBS) | | VOLUME (FT3) |
| COMMODE ASSY * | (100) | 372(4)= 559 | 916 |)= 137 |
| DEY/KET WIFES | | | el | 4.2 |
| | | ****************** | | |
| | | | | |
| | | | • | , |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | TATCT | 293.5 (64 | 7/) | 3.99 (141.2) |
| | | KG (LBS) | <u>///</u> | M ³ (FT ³) |
| KINCONDES INITIAL U | igiant of c | OLLECTOR BAGS | | , 10 (61-7) |
| <u>50LI</u> | D EXPENI | DABLE WIVOL | REQUIREMENTS | • |
| | | ② ③ | (f. 5.5. | |
| | U (PKG | /UNIT (REF) WT/CYC .WT/UNIT)(REF) ①X((LB) (LB | CLE VOL/UNIT (SEF 2) (PKG.VOL/UNIT)(|) VOL/CYCLS REF) (1) X (4) (FT3) |
| | YCLE(REF) | (LB) 4/15½ (250)031 | | |
| | _ | | | 250) _001975 |
| WET WIPES 1 | | 770 (30) .049 | | 50) -00184 |
| collector bags 1 | (100) | 229 (87:03) .229 | 20068.68 | 749_0668_ |
| | | | | · • • • · · · · · · · · · · · · · · · · |
| | | | | |
| | | - | | |
| | | Σ 3 309 | · D | (5) .0/06 TOTAL VOL/CYCLE |
| | | (LB) |) | (FT3) |
| TOTAL NT. MISSION 6 | x 184 | x ,309 | . 159 | 4.9 (340.9) |
| CYCLES/DAY | DAYS/HI | ssion for with cycle (LB) | .E | KG (LB) |
| TOTAL VOL | e e | _ | | |
| MISSION CYCLES/DAY | _x184 | X X O/OG SSTON TOT, VOL/CYC | · • | 33 (//·7) |
| | 211127772 | (FT ³) | | (, |
| | | | • | • |
| G A S/ | ridald i | EXPENDABLES E | REQUIREMENTS | |
| • | | 0 | ③ | 4) |
| | AMT.USED/CYCLE(F | branus.u | AMT. RECOVER TO/CYCLE | AMT LOST/CYCLE |
| TYPE | (LB) | FACTOR | ① x (?) | (LB) |
| DXYGEN | 126_ | <i>N/A</i> | <i>N_A</i> | -126 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| $\Sigma \odot$ | 126 | | Σ \odot | .126 |
| ' | | • | | |
| TOTAL WT | 184 | x .126 . 1. | 38.7126 | 62 9 (138.8) |
| CYCLE/DAY | DAYS/MISSIO | TOTAL LOSY/CYCLE -12 | (LB) (Z (D) | ks ((h) |
| | | ν. (J.) | (LD) IE U | |

SPACECRAFT Space Station

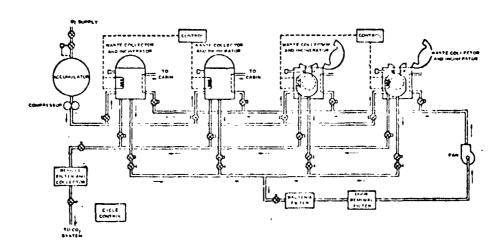
Waste Collection/
HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer

APPLIANCE FUNCTION Fecal Collection/Transfer

APPLIANCE CONCEPT NO./TITLE 7/Wet Oxidation

INDEX NO. 2.1.1.7 REF. NO. 100,250, & Skylab data, 247

catalytic process. The system employs an insulated chamber similar to the incineration and decomposition concepts. Waste treatment is accomplished by charging the chamber with 500 psia oxygen at ambient temperature and applying heat to bring the chamber up to oxidation temperature. The final pressure and temperature are approximately 1750 psia and 550°F. The advantage of the wet oxidation process is the production of water which can be processed and reused in the spacecraft. The system requires a high pressure oxygen source, assumed in this study as a compressor. A stirrer would enhance the wet oxidation process, but was not considered in the study due to lack of engineering data. Based on two data sources, the process was assumed to take 12 hours, most of which is cooldown time (10½ to 6 hours). The collection bags described in Concept 4 are also used for this concept. Wet and dry wipes are used for this concept and are assumed to be deposited into the collector.



INDEX NUMBER Z. 1.1.'

ELECTRICAL POWER BEQUIREMENTS

| | | _ | Α. | C POHE | R | D (| POWE | R |
|--|-----------|-----------------------|----------------------|---|---|----------------------|------------------------------|-----------------------------------|
| COMPONENT | (REF) | USE TIME CYCLE (HR) | ② PEAK (WATTS) | 3 AVERAGE (WATTS) | (4) DEMAND (WATT-HE/ CYCLE) (1) X (3) | © PEAK (WATTS) | & AVEPAGE (WATTS) | (/) DEMAND (WATT-HR/ CYCLE) ① X ⑦ |
| AIR IAIS I SOLLHOIDVA KISHVE COL | 14/12 (3) | MOMUNICA | <u>250</u> | <u> 180 </u> | 1080 | 56. | _56_ | |
| SOLEMOID A | 1116653) | 4 | | | | 64 | 64 | / |
| HALVES HUNTER COMPRES | (13) | <u>''</u> | 350 | 200 | 100 | 104 450 | 109 450 | 2700 |
| CONTROLL | | 12 | 60:0 MAXIHUM . | American | 1180 TOTAL | 30 704 MAXIMUM | 20 | 290 2940 TOTAL |

THERMAL REQUIREMENTS

| • | SOURCE | LATENT (BTU/HR) | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
|------|---------------------|--------------------|--|---------------------------------|---------------------|
| | NKÉCUMPRESSOR MOTOK | | 2050 | 2050 | _N/A_ |
| HEAT | EK | | _1536_ | : | |
| | | | - | • | , |
| ` | TOTAL | WATT (BTU/HR) | 1 <u>051.(-(3586)</u> WATT (BTU/HR) | 1051.U(3.5.96) WATT (BTU/HR) | WATT (BTU/HR) |

QPERATIONAL PENALTIES

| ` . | , · Source | THE HEAT LEAK (BTU/HR/CYCLE) | RMAL TO COULANT (BTU/HR/CYCLE) | ELECTRICAL (FK WATTS/CYCLE) | WEIGHT (LB/MISSION) | VOLUME (FT ³ /MISSION) |
|------------|---------------|------------------------------------|--------------------------------------|-----------------------------|----------------------------|--------------------------------------|
| | - N/A - | | . — — , | | 0 | • |
| | | | | | | |
| <u>,</u> | | | | | | |
| ٠ | ATOT | MATTS/CYCLE (BTU/HR/CYCLE) | WATTS/CYCLE (btu/HR/CYCLE) | | AG/MISSION (LB/MISSION) | M³/MISSION (FT'/MISSION) |

C2-164

| APPLIANCE CONCEPT | REQUIPERENTS AND PERALTIES CALCULATIONS | (COACE ONE D) | |
|-------------------------|---|---------------|-------|
| CONCEPT 7/WIT OXIONTION | | INDEX NUMBER | 1.1.1 |

| | <u>FIXED</u> WI | EIGHINAOLA | ME <u>R</u> EQ | <u>UIREMENI</u> | <u>r ş</u> | |
|------------------------------------|--------------------------|--------------------------------------|----------------------------------|------------------------|------------------------------|--|
| COMPONENT SOLUTIONS A WEST DEY A | | 1053 (| WEIGHT (LUS) | | | OLUME FT1) |
| see to 4 des 4 des | | | | | | |
| | | | | | | |
| | | | | | | |
| | TOTAL | 724 | .9 (1595 KS (LBS) | ?:1) | 6.4 N3 | (ZZ6.Z) |
| INCWOES I | NITIAL WEIGHT | | OR BAGS | EQUIREM | , " EN " S | |
| TYPE | • | WT/UNIT (REF) PKG.WT/UNIT)(REF) (LB) | MI / CYCLE | VOL/UN (PKG.VOL | (A) IT (REF) /UNIT)(PEF) T3) | (5) VOL/CYCLE (1) X (4) (F13) |
| DRY WIPLS | 3 (250) 2 | | 1_0312 | , | _ | .001975 |
| WET WIPES BOLLEGICH BA | (150) 3 (45 1 (100) = | .4/70_{250 | | | 170 (LSC) E (SFYLAG) | |
| | | | | | | |
| | | | | | | - |
| | | Σ3 |) 309 TOTAL WITCH (LB) | at- | Σ⑤ | .0106 DIAL VOL/CYCLE (FT3) |
| OTAL WT. MISSION CY | ELESZDÁY X Z BAYSZ | 3 <i>4</i> Missiov x _ | 309 101.117.CYCLE (LB) | • | 154.9 KG | (18 (340.9) |
| OTAL VOLCY | CLES/DAY X /E | MISSION X | -0/06- 101.VOL/CYCLE (F13) | • | .33 _n , | 7(((-7) |
| | <u>6 A S/L 1 Q U 1 D</u> | EXPERDAI | | Q <u>uireme</u> | | • |
| TYPE | AMT.USED/CYCL (LB) | E (REF) | PRECOVERY FACTO | AMT. RECOVERED (LB) | /CYCLE / | (LB) |
| OXYGEN | | | N/N | <i>N/</i> A_ | | .169 |
| | | | | | | |
| 1 | Σ ①169_ | | | | Σ : | 169 |
| OTAL WT | 6 x 184 | x .169 | . 180 | 2.6 + .16 | 9 . 5 | 4.7 (186.7 |

(LB)

te O

D2 #2560 4

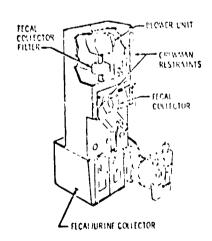
SPACECRAFT Space Station Waste Collection/
HABITABILITY SUBSYSTEM Personal Hydicae HABITABILITY FUNCTION Transfer

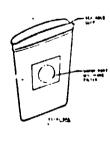
APPLIANCE FUNCTION Fecal Collection/Transfer

APPLIANCE CONCEPT NO./TITLE 8/Semiautomatic Dag System (Skylab)

INDEX NO. 2.1.1.8 REF. NO. Skylab data,283,250,100

DESCRIPTION The semiautomatic bag concept consists of a wall mounted fecal collector unit using a collection bud, with air entrainment of the reces. The fecal collector consists of a fecal collection recentacle, a mesh liner, and hinged seat. The hinged seat provides access to the mesh liner to permit manual installation of a fecal bag. The seat is contoured and contains airflow holes to allow cabin air to be drawn into the fecal bag as a evity substitute airflow. The seat upon closure provides an integral seal between the fecal bag and the fecal collection receptacle and between the seat and the user. A blower unit is utilized to provide feces entrainment into the fecal bag. Cabin air is drawn into the fecal bag and is exhausted through the collection bag's vapor port, through the mesh liner and into the fecal collection receptable. The cabin air is then passed on to the fecal collector filter and blower unit and returned to the cabin. The fecal bad is manually removed from the fecal collector after each derecation and replaced in mediately with a new bag. The fecal bag with its contents is then vacuum dried in a waste processor to facilitate on-orbit storage. The waste processor is a separate unit and is included as a part of this concept.





1/5

INDEX NUMBER 21.1.

| | A_(| C POWE | R | D | C POWE | |
|--|-------------------|---------------------------|-------------------------------|------------------------|-------------------------|---|
| USE TIM CYCLE COMPONENT (REF) (HR) | CE ② PEAK (WATTS) | (3) Average (Watts) | DEMAND (HATT-HR/ CYCLE) ① X ③ | (5) PEAK (WATIS) | 6 Averace (Watts) | (7) BEMAND RH-TTAW) V(7) X (D) |
| AIK FILK ASSY (DKSV48) . Z HENILES (3) (253) | 250 | 180 | 36 - 200 | 225 | 225 | 225 |
| VACUUM PUMP (233) L CONTROLUMITIMALIZA) L | | | | _30_ | 20 | Z |
| | | | | | | |
| | MAXIMUM . | | 236 TOTAL | 255 MAXIMUM | | 245 TOTAL |
| · . | | | | | | - |
| | THERMAL. | REQUIE | REMENTS | | | |
| • | LATENT | SEN! | SIBLE | HEAT LEAK | | COOLANT |
| • SOURCE | (BTU/HR) | (B TL | J/HR) | (BTU/HR) | 3) | ITU/HR) |
| ALR ERN MOTOR | (BTU/HR) | | 00_ | 800 | | V/A |
| • | (BTU/HR) | _8 | | | | Y/A Y/A Y/A |
| AIR FAN MOTOR | (BTU/HR) | | 92 | _800 _768 | | (BTU/HP) |

OPERATIONAL PENALTIES

| • | SOURCE | HEAT (TAK (BTU/HR/CYCLE) | RMAL TO COOLANT (BTU/HR/CYCLE) | ELECTRICAL (PK WATTS/CYCLE) | WEIGHT (LB/MISSION) | VOLUME (FT³/M155104) |
|-------------|---------|-------------------------------|--------------------------------------|--------------------------------|----------------------------|-----------------------------|
| | - N/A - | | | | • | |
| | | | | | | |
| | , | | | • | | |
| | | | | | | |
| | | | Naumanathan | | | |
| | TOTAL | WATTS/CYCLE (BIU/IR/CYCLE) | WATTS/CYCLE (BTU/HR/CYCLE) | | KG/MISSION (LB/MISSION) | M'/M155104 (FT'/M155104) |

1/5

APPLIANCE CONTINUE AND PRINCIPLES CALCULATIONS (CONCLOSED)

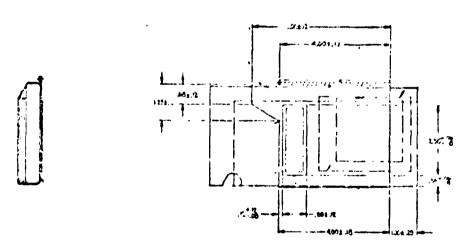
CONCLETE STATEMENT OF THE STATE

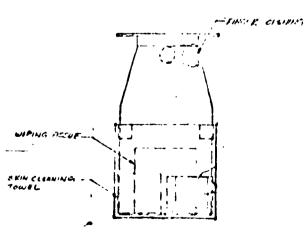
| <u>E I X E.B</u> | WEIGHT | A othut Bi | $\delta \cap T \not \to E \not \in R \not \in$ | NIS | |
|--|----------------------|---|--|---------------------------------------|-----------------------------------|
| COMPONENT (REF | | WEIGHT (LDS) | | | (E1.) AOI IINE |
| Commone feomeoneurs CK | YLAB) | 2.10 | | ***** | |
| COLUCTION BAGS | | 251 H | • • • • • • • | | |
| | | | e more | | |
| | | | | | |
| | | | | | |
| | | | | · | |
| | | | | | |
| | | | | | |
| TOTAL | | 249.9 (550 ' KG (LBS) | 0.9) | | 81 (28.7) M ³ (FT') |
| <u> </u> | PENDABL | E WIJYOL | <u>REQUIR</u> I | EMENTS | |
| | Ø) tinu∖ tw | EEF) WI/CYG |) [1 | ./UNIT (PEF) | VOL/CYCLE |
| TYPE UNITS/CYCLE(PEF) | (PKG.WT/LP() (LB) | T)(+(1) (1)+(1) | | .VOL/JU11)(FEC |) <u>(FIP)</u> |
| DKY WIPES 3 (250) | | ((CSO) .0312 | | | • • |
| WET WIPES L (250) | | (130) .0130 | | 2/10 (250) | |
| COLLECTION BAGS 1 (100) | | X1910229 | | • | |
| arite and an incident and an i | | | | | 9.13023 |
| | | | | • • • • • • • • • • • • • • • • • • • | |
| | | | | | |
| | | Σ3 3cc | | Σ | 16146 . 17CYUE |
| TOTAL III | | (LB) |) | | (FT3) |
| TOTAL PT CYCLES/040 X | 184 Days/Miesion | . X := .309 101.61/CtCl (IE) | £ . | 154. | (540.4) |
| TOTAL VOL. | 121 | 0106 | • | 1 32 | (11.7) |
| CYCLES/DAY 1 | DVAZNAZOTOM . | x | ĴΕ | ني <u>ب</u> و _{سيا} | MT ((1)-7) |
| <u>ē ¥ \$/</u> ţ <u>ī</u> Q <u>u</u> 1 | D EXPE | hDABLES F | REQUIRE | 4 ENTS | · |
| and the second to the control of | | 0 | | ტ | (1) |
| AMT. USED. | O (CYCLE (PEF) | RECOVERY | AMT . RECOVE | | AMT LOST/CYCLE ①-③ |
| TYPE | (t B) | FACTOR | | B) | (18) |
| | ~~~ -~~~ - · · · · · | | , | | |
| administration of the second s | | | | | |
| | | | | | |
| | · | | | | |
| F & | | * ************************************* | | T A | |
| Σ ① | | | | \sum (4) | |
| TOTAL NT. | • | • | | _ [| |
| MISSICY DAYS/M | ISSION X | ΛΕ ΕΘΊΤ/ΟΥΟΙΕ * ΌΣ (Φ) | • (18) | (z (i) | kg (LE) |

SPACECRAFT Space Station Waste Collection/ HABITABILITY SUBSYSTEM Personal Hydiene HABITABILITY FUNCTION Transfer Fecal Collection/Transfer APPLIANCE FUNCTION 9/Dry Bags (Apoll) APPLIANCE CONCEPT NO./TITLE Apollo dwgs: V36-601029, V36-601390, 2.1.1.9 INDEX NO. REF. NO. V36-601267, V36-601398, V36-787819, and V36-787800 DESCRIPTION The dry bag concept consists of bag which is tared to the buttocks of the crewman. The collection system is manual and requires a large amount of crew time per defecation. The unit is co-pactly folded for storage and each unit contains biocide and tissues. The bag is unfolded, taped to the buttocks, the botus is separated using the built-in finger, and the tissues are deposited into the bag. The bag is closed, sealed and the biocide is kneeded into the feces

for germicide control. The collection bags are deposited into a large bag which has a capacity for 16 feces collection bags. The dry bags were used on Apollo

and were provided as a backup for Skylab.





| , | ELECŢ | RĮCAĘ | POWER | REQUIRE | MENTS | | |
|-----------------|-------------------|---------------|-----------------|-----------------------|-----------------|------------------------|---------------------------|
| | | | C POWE | | | POWE | , R |
| | CACFE Nol Time | (2) PEAK | (E) AVE PAGE | ORPHAND (MATT 1697 | (S) PEAK | (6) AVEFA'sE | (7) DEPAND USBITANI |
| COMPONENT (REF) | (HR) | (MATTS) | (WATTS) | (1) x (3) | (WATIS) | (WATTS) | (1)x() |
| | | | | | | | |
| | | - | *** | | | | |
| | | | | | | - | |
| | | *********** | | | | | and the second second |
| | | | | | | | |
| | | MAXIMUM | | TOTAL | MUMTXAM | | TOTAL |
| | | | | | | | |
| | TOTAL | | | | | - | |
| | i . | WAIT (BIU/HR) | WATT (| (BTU/HR) | Mark to the sty | WAIT | (BTU/HR) |
| | | | | | | | |
| | | | | | | | |
| | <u>o</u> ! | PERATIO | NAL PE | N A L T 1 E S | | | |
| | HEAT (| THERMAL | TO COOLANT | ELECTRICAL | WEIGHT | | DLUME |
| SOURCE /. | (BTU/HR/C | .YCLE) (B | TU/HR/CYCLE) | (PK WATTS/CY | CLE) (LB/M1551 | ON) (FT ³ . | /MISSION) |
| | | | | | | | |
| | | | | | | • | |
| | | | | | | | |
| | | | | | | | |
| 1 | OTAL | | | | | | |
| ī | THAT IS | 7070F | ATTS/LIGHT | | KG/MISSI | (N 417) | 115510N |

APPLIANCE CONCEPT PECHIFICHEN AND PENALTIES CALCULABIONS (CONCEUDAD)

1/5

CONCIPT 2/DRY BASS (APOCLO) INDEX NUMBER Z. /. /. WETWHI/VOLUME WEIGHT (LES) COMPONENT COLLECTION BAGS 270.8 STOWNEY BASS TATOT REQUIREMENTS EXPENDABLE M I/A O F UNITS/CYCLE (PEF) COLLECTION BASS 1 SICWAGE BACK .055 B CICLES/BAY X 184 X 244 TOT.WIFCHELE ... --- 016 + 5/14 Y -- X -- 184 DAYS/MISSION .54 (19.4) * INCLUDES TOTAL FLICES AND RAG VOLUME EXPENDABLES REQUIREMENTS AMT. PECOVER TO ACYCLE AMT. USED/CYCLE (REF.) (LL) Σ 0 Σ TOTAL TEST/CYCL (LE)

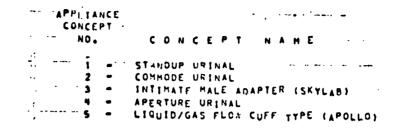
D2 H25ch 4

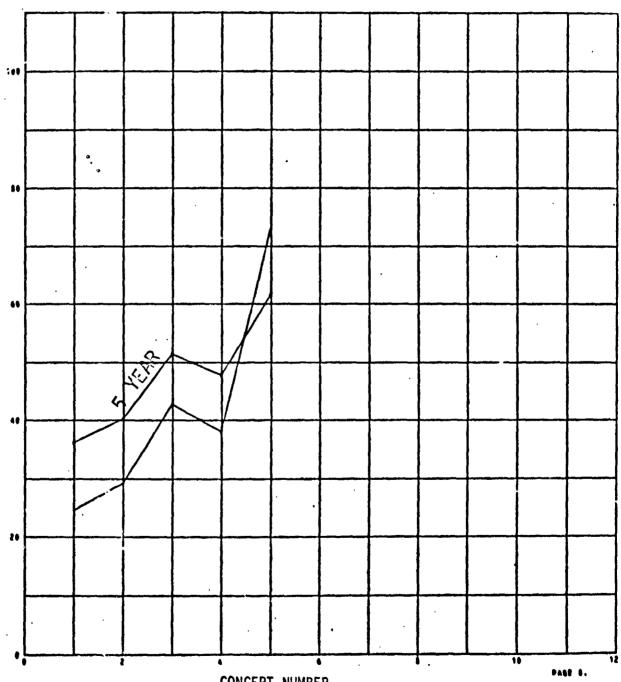
| HAMITABLETY SUBSYSTEM | 2.0 | Personal Hygiene |
|------------------------|---------|---------------------------|
| HABIT DILITY FUNCTION_ | 2.1 | Waste Collection/Transfer |
| APPLIANCE FUNCTION | 2.1.2 | Urine Collection/Transfer |
| NUMBER OF CONCEPTS CON | SIDERED | 5 |

ASSUMPTIONS

- (1) The urine collection/transfer concepts consider air entrainment and intimate male adapter methods of collecting urine.
- (2) The study assumed a total of 42 uninations per day (seven per day per man). The concept use time required per unination is dependent on the concept type.
- (3) Filter weight and volume were included if a high replacement frequency is required. Periodic filter replacement was not included in the study.
- (4) Component power requirements were normalized to provide a fair comparison of all concepts. The power requirements were not based on the latest urine collector designs. This was done because the various manufacturers were in precess of a competitive proposal response for the Shuttle waste collection system and could not be contacted for additional information.
- (5) In the case of Space Station, the urine and rinse water was assumed to be collected and processed through a vapor compression distillation unit. Urine recovery was based on 24.8 grams of solids per 1000 grams of urine. The solids were then ratioed by the amount of flush water used. The recovery factor used was 98.15 percent. The Shuttle concepts were considered to be dumped overboard or collected, but no water processing was applied.
- (6) The urine collection devices were alrocated one per vehicle
- (7) The urine collection devices considered are adaptable to men only; however, when combined with a fecal collector, some of the devices can be adapted to females.

| | | | | GEZ GEZ | |
|--|---|--|-------------------------------|--|--|
| | • | | | AL OR | |
| 0.7 3.7 4.7 4.6 4. C. O. | CONCEPT FUNCTION MATRIX | : | | PAG | 1 |
| INDEX NO. 2-1-2 URINE COLLECTION/TRANSFER (SPACE | E STATION) | | | je is ality | ; |
| CONCEPT, USAGE CONSUMASLES AND FLOW REQUIREMENTS | THERMAL REGATS | ELEC PPR REGHTS | WT/VOL REGNTS | . | . A Jados Bir |
| | Md | THE SAME TO SA | 340102 134 | AVAIL INDEX | WE IGHT |
| | A1154 14A1154 U/KR1 (81U/KR) | BC - BC | | - | -KG- |
| 0.0003 4.44 0.00001 20.003 (.0 0.0001 20.003 (.0 0.0001 20.000 (.00.0 | 248, | 226.0 114.0 | 1 46.5 . 25 322.91 (8.67) | 2 50 | (202.1) |
| 2 42.000 1 .0000 0.04 .0 21.1 .017.000 1 .000 2 .00 | 0. 22%. (0.1 (7ale) | 226.0 114.0 | 227.22_(_17.50) | 5 2 2 | 62.2 |
| .0000 4.44 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0 | 6 001 (7810) | 226.0 114.0 10.0 19.0 (| 263-27 (6-31) | 1 10 | 4 210.61 |
| 4 42.000 1 .00.00 9.44 .0 21.1 .017 1 .00.01 20.001 (.0) (70.0) 5 .147 36.29 1551.4 32.2 | 0. 224. (0.) (781.) | 10.0 110.0 | 82.6 .09 187.51 (3.151 | 2 38 | (137.2) |
| 235 21 4 72 | (00) | 000 | 3513.0 .17 7744.81 (6.06) | 1. | 3432+1 |
| ### CONCEPT C 0 W C E F T W A M E 1 - CABI #### CANDOW UNINAL 2 - CONMONE UNINAL 4 - CONMONE UNINAL ADPTER (SKYLAB) 5 - WATE ################################### | CABIN AIR (CIRCULATED), L CABIN AIR (LOST) , K OXYGEN (LOST) , K COOLING WATER (CIRCULATED), K HITRCSEN (CIRCULATED), K NITRGEN (CIRCULATED), K FREON (CIRCULATED), K MATER (WEO) | LITERS/SEC (FT ³ /M1M) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) KG/HR (LB/HR) | 3000 | (**)AVAILABLE AVAILAGLE STATE OF THE ART SOME DEVELOPMENT REQUIRED EXTENSIVE DEV. REQUIRED | (***)COST 11,116.102 0-25 25-502 50-752 75-1008 |





CONCEPT NUMBER

Urine Collection/Transfer (Space Station) Concept Trade

| | | | | 15910 | | | | | |
|-----------------------|------------------|-----------------------------------|---------------|-----------|-------------|---------|--------------------|------------------------|--------|
| | SELECTION MATRIX | | 101/30/751 | • | URINE CO | LLECTIC | OLLECTION/TRANSFER | SFER (SPACE STATION) | |
| FACTOR | MIN | MAN | 915 | - | 2 | • | 2 0 0 | E P. T. | |
| BE I GHT | 182.55 | 9.4464 | 15 | 14.37 | 14.56 | 14.49 | 14.65 | 000 | |
| POFER | 3.1533 | 17.563 | 51 | 50.5 | 00. | 6.39 | 8.20 | 13.60 | C |
| THERMAL PF: TAREY | 00000 | 108.29 | | 80. | 1.15 00. | | - 51 - 1 - 1 | h6.4 | 2. |
| MAINTENC. DEV COST | | 1 • 00000 50 • 000 60 • 690 | 2.25 | | 7.50 | 12.00 | 4.50 | 4,98 12,00 58,46 | 1185 |
| | ii | 100.00 | 100 | 100_24.34 | 29.02 | 42455 | 37.90 | 73.07 | C1 - 4 |
| | | | | | | | | | |
| | | OF | ORI | | | | | | |
| | | BOOR | GINAI POOF | | | | ŀ | | |
| | • | | PA | | | | | | |
| | | | GE | | | | | | |
| | | | R | | | | | | |
| | | | | • | | | | | |
| | | | | | | | - | | |

:

(

, 1,

| SINGLE SFLECTION PARAMETER IN FOLINGS 1 |
|---|
|---|

| SELECTION HATRIX • • • • • WRINE COLLECTION/TRANSFER (SPACE STATION) FACTOR VALUE PTS 1 2 3 4 5 5 6 7 7 4 6 7 7 6 7 6 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 6 7 7 7 6 7 7 7 6 7 7 7 6 7 | ### ################################## | SELECTION MATRIX * * * * * * * * * * * * * * * * * * * | SELECTION HA MIN VALUE 182.55 -00000 -07000 -07000 -07000 -07000 10.700 | | | | | D2-11850 |
|--|---|---|--|---|---|---------------|--|-----------|
| HIN | ### #### ### ### ### ### ### ### ### # | | MIN VALUE 172.55 .00000 .00000 .97040 .99999 10.000 | | 5.05 5.05 6.05 6.05 7.05 7.05 7.05 7.05 7.05 7.05 7.05 7 | 2 0- 27 8 | 14 . 65 15 . 6 . 6 . 6 . 6 . 6 . 6 . 6 . 6 . 6 . | D2-118-50 |
| 182.55 7744.8 | -00000 100.00 10.56 14.49 14.45 .00 | | 142.55 • 05550 • 0550 • 97540 • 9999 10.306 | 22220 | 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 2 - 2 - 2 - 3 | 15.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2 | D2 11850 |
| 3.1500 17.500 10 5.65 .00 6.39 8.20 6.54 -97040 19964 5 .00 1.15 1.15 15.00 -97040 1.00000 | 11500 17:500 10 5:05 .00 6:39 6:20 6:39 6:20 6:39 6:30 6:39 6:39 6:30 6:39 6:30 6:39 6:30 6:39 6:30 6:30 6:30 6:30 6:30 6:30 6:30 6:30 | 11500 17500 17500 10 5.05 .00 6.39 6.20 6.59 6.20 6.39 6.20 6.59 6.20 6.39 6.20 6.39 6.20 6.39 6.20 6.39 6.20 6.39 6.20 6.39 6.39 6.30 6.30 6.30 6.30 6.30 6.30 6.30 6.30 | 3.1500 .00000 .97040 10.000 | 5 N N 4 N N N | 200 003 003 004 004 004 004 004 004 004 0 | 27.7 | 15. | D2 11850 |
| 97340 99964 5 03 00 050 943 4.94 99999 1.00507 5 05 05 00 050 4.59 10.300 50.050 15 00 7.50 12.00 4.55 12.00 137.20 7566.4 15 14.63 14.73 14.56 14.73 00 005000 \$5.059 95 34.67 37.94 48.60 45.04 58.45 005000 105.00 100 35.87 39.94 51.16 47.41 61.53 | 10 10 10 10 10 10 10 10 | 10-700 50-000 15 -00 -00 -00 -00 -00 -00 -00 -00 -00 -0 | . 97340 . 997940 10.300 | 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 | 62 | 27.7 | 12. | D2 11850 |
| 137.20 50.000 15 .00 7.50 12.00 4.50 12.00 137.20 7566.4 15 14.60 14.73 14.56 14.73 .00 .00000 \$5.000 95 34.07 37.94 48.60 45.04 58.45 .00000 100.00 100 35.87 39.94 51.16 47.41 61.53 | 10-700 50-000 15 -00 7 50 12-00 4-50 12-00 17-20 75-6-4 15 -00 17-20 75-6-4 16-73 -00 17-20 75-6-4 16-73 -00 17-20 75-6-4 16-73 14-6-5 17-6 77-41 61-53 | 137.20 50.000 15 .00 7.50 12.00 13.2 | 10.300 | 2 2 2 | 60 | 8 - 7 | 12. | 11850 |
| .00000 100.00 100 35.87 39.94 51.16 47.41 61.53 | .00000 100.00 100 35.87 39.94 51.16 47.41 61.53 | .00000 100.00 100 35.87 39.94 51.16 47.41 61.53 | | 56 | | 5 | 58. | 50 |
| ING .00000 100.00 35.67 39,94 51.16 47.41 61.53 | 100.00 100.00 100 35.67 39,04 51:16 47.41 61.53 | 100.00 100 | AL PT . 00000 | | , | 1 | 1. | |
| | | | ING .00000 100. | 100 | 5.67 39.9 | 2 | ÷ | 13/ |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | • | | | | | | |

| | | | İ | - | | | |
|----------------------|----------|-------------------|-----------|---------------------------------------|------------------------------------|-----------------------------------|------|
| | | : | ; |) N 0 0 | _C E P T | | |
| MORHAL | 35.87 | 39.94 | 51016 | 17.41 | 61.53 | 00 | |
| BEIGHT | 40125 | 44.12 | 87.7 | 51.09 | 57.93 | RIGI E P | |
| POMER | 36.60 | 37.01 | 51.80 | 7 | 61.72 | NA OO | |
| THERMAL | . 33.24. | 37.58 | 47.98 | * * * * * * * * * * * * * * * * * * * | 64.35 | | |
| MAINTENC | 7.96 | 38.91 | . 49 · 85 | 46 . 34 | -62.51 | P A | |
| DEV COST REC_COST | 10.36 | 49.20 | 54.52 | 51.12 | 57.03 | ge d | |
| | | | | | | | 1135 |
| | | | ENSITIV | SENSITIVITY ANALYSIS | LYS15_ | | |
| | SINGLE | SINGLE SELECTION. | | 0 K W | EPT AFTER BEIGHTLY MAX POINT | INCREASING IG_EACTOR BY = SD & | |
| | | • | | ' ≥. | E III | | |
| : | _ | i . ~ | _ | • | Ŋ | | |
| HORMAL | 35.87 | 39.94 | 21.16 | 17.41 | 61.53 | | |
| WEIGHT | 30.73 | 35.34 | 47.26 | | 16.66 | | |
| POKER VOLUME | 35.05 | 43.30 | 51.45 | 45.49 | | | |
| THERMAL | 38.94 | 42.70 | £ 4 . B 9 | - 1 | - 1 | | |
| RELIABOV | 34.82 | 41.02 | 52.54 | 40.00 | 60.54 | | |
| | 38.44 | 39.07 | | # 4 | 59.95 | | |
| AEC COST | 30.60 | 7 × 0 × 7 | • | • | , | | |

SENSITIVITY_ANALYSIS

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 2.1.2-URINE COLLECTION/TRANSFER

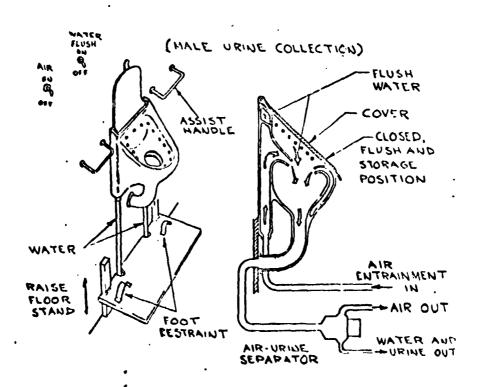
| · · · · · · · · · · · · · · · · · · · |
|---------------------------------------|
| |
| |
| |
| |
| |
| - |
| |
| |
| |
| |
| |
| • |
| |
| · |
| |

D2:118501 4

| SPACECRALE Space Station . | Waste Collection, |
|---|-------------------|
| HABITABILITY SUBSYSTEM Personal Hydiene HABITABILITY FUNCTION | |
| APPLIANCE FUNCTION Urine Collection/Transfer | |
| APPL ARCL CONCEPT NO./TITLE 1/Standup Urinal | |
| INDEX NO 2.1.2.1 REF. NO209, 273, 2 | 07 |

DESCRIPTION

The standup urinal concept consists of a collector utilizing air entrainment for collection and transport of the urine and centrifugal separation of the air/urine. The cabin air used for entrainment is filtered and recirculated back into the cabin. The unit is mounted on the wall of the spacecraft. The unit is activated by opening the cover. After use, the cover is closed; a fixed quantity of flush water is used to flush the urinal. The unit automatically shuts down after the flush is completed. The total operating time was assumed to be one minute using 45 seconds as an average urination time. The flush water assumed used per cycle was 0.8 pound and was heated to 90°F. A pretreatment chemical was added to the flush water.



1./5

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCLET 1/STANDUP URINAL INDEX NU "HER Z. 1.7. 1 ELECIRICAL POWER REQUIREMENTS POHER POWER DEMAND NATT-NY USF TIME (7) DEMAND (WATT-HR/ 2 **③** (3) **(**6) CYCLE PEAK AVERAGE PEAK AVEKĀGĒ CYCLE) () x() COMPONENT (REF) (HR) (WATTS) (WATTS) (WATTS) (WATTS) ①×① AURITAN/SETAFAIGR 1201.0125 100 200 UPINC PUNIP <u> 2510 -</u> SOLUMOIOVALVES(Z) MAIMUHIART MOTOR VALVE MODENIARY .034 CONTROLLER/TIMEZ .017 226 1.37 .034 MUNITION TOTAL MUMIKAN TOTAL IHERMAL, REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COOLANT SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) MOTORS (FINESEPAPATOR) FLUSH WATER COOLDOWN TOTAL WATT (BTU/HP) WATT (BTJ/HR) WATT (STU/HR) WATT (BTU/HR) QPERATIONAL PENALTIES THERHAL TO COGLANT ELECTRICAL ME IGHT VOLUME HEAT LEAK SOURCE (PK WATTS/CYCLE) (LB/MISSION) (FT3/MISSION) (BTU/HR/CYCLE) (BTU/HR/CYCLE) TOTAL KATTS/CYCLE (BTU/BR/CYCLE) WATTS/CYCLE (113/M12210A (113/M12210A) KG/HISSION

(LB/MISSION)

(BIU/HR/CYCLE)

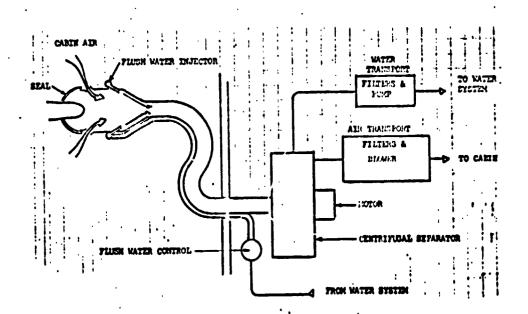
15

APPLIANCE CONCEPT REQUIPEMENTS AND PERALTIES CALCULATIONS (CONCLUDED) CONCEPT 1/STANDUP URINAL INDEX NUMBER 2.1.2. . 1 WEIGHT/VOLUME REQUIREMENTS WEIGHT (LBS) (REF) COMPONENT 115 URINAL/COMPONENTS (209) TOTAL 52.Z (115) KG (LBS) M3 (FT3) EXPENDABLE MI/VOL REQUIREMENTS SOLID VOL/UNIT (PEF)
(PKG.VOL/UNIT)(PEF)
(FT) WT/UNIT (REF)
(PKG.WT/UNIT)(REF)
(LB) TYPE UNITS/CYCLE(REF) TOTAL VOL/CYCLE (F13) NOTAL WT/CYCLE TOTAL NT. MISSION CYCLES/DAY DAYS/MISSION X YOT.WI7CYCLE (LB) MISSION -TYCLES/DAY X DAYS/MISSION X YOY. VOL/LYCLE (FT3) GAS/LIQUID EXPENDABLES REQUIREMENTS ANT . RELOVE HED/CYCLE RECOVERY AMT.USED/EYCL('EF) FACTOR ELUSH WATER 1-,0185 PRETRUATMUNT Σ0 .8/2 Σ@ __0253 199.4 . 1812 .

| SPACECRALT_ | Station. | An and the first of the second | Waste Collection/ |
|--------------|----------------|--|--|
| HABITABH 11Y | SUBSYSTEM Pers | onal Hygiene MARITABILITY | FUNCTION Transfer |
| APPLIANCE FU | RCTION Urin | e Collection/Transfer | |
| APPLIAL E CO | rcupt NO./DITU | 2/Commode Urinal | and diver the second control of the second s |
| INDEX NO. | 2.1.2.2 | RFF. NO. 20 | 7, 209, 273 |

DESCRIPTION

The commode urinal concept consists of a urine collector, centrifugal separator, and flush unit. This unit would be used where combined feces and urine collectors are defined. The unit uses a flush as described in Concept 1; however, 0.33 pound per flush was used because of the smaller surface area requiring biocide treatment. Air entrainment is employed coupled with a properly directed urine stream. The operating time is the same as specified for Concept 1. Cabin air used for urine entrainment is filtered and returned to the cabin.



APPLIANCE CONCLPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT 2/COMMONE URINAL

INDEX NUMBER 2.1.2.2

| CONCEPT 2/Common | EUKIN | AL | | | | INDEX | NUMBER | ر کرد کے م |
|---|-------------------|--|---------------------------|-------------|-------------|-------------------------|-------------|--------------|
| | ETEC | IBLCAL | | | UIREME | | | |
| | \bullet | | A C P | OWER | <u> </u> | D C | POWE | |
| | USE TIME | (2) | (3 |) or | MAND | (3) | 6 | (7) Deman |
| | CACLE | PEAK | | LCE (WAT | T-HR/ | PEAK | AVERAGE | H-TTAW) |
| OMPONENT (REF) | (HR) | (WATTS |) (WATT | (s) | (E) (| WATTS) | (WATTS) | CYCLI) |
| URIFAH/SLEARATURIA | 0) 0125 | _200 | 100 | | 25 | | · | |
| IRINE PUMP | ماران 0125ء | | | | 17 - | | | |
| SOLUTIONO VALVESTA | | | | Y | | 16 | 16 | |
| HOTOR VALVE | j inggasana Ji | ~ | - 4 | | | | | , |
| UNIROLLER/IIDIO | | . ــــــــــــــــــــــــــــــــــــ | عید مید میده | | | Z | 7 | .0. |
| MILLE W. W. LEGGLICH | | | | | | , | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | • |
| | | 22% | , . z_ | | <i>3</i> 7 | 18 | • | _03 |
| | | MAXIMU | 1 | . 10 | TAL M | AX I MUM | · | TOTAL |
| | | | | • | | | | |
| • | | | | | | | | |
| | • | • | | | | | | _ |
| | | | | • | | • | | - |
| | | IMERM | AL. REG | UIREME | NIS | | • | • |
| • | | LATENT | | SENSIBLE | | HEAT LEAK | TO | COOLANT |
| i SOURCE | | (BTU/HR) | 1 | (STU/HR) | | (BTU/HR) | | BTU/HR) |
| • | | | | (0.0) | | | • | • |
| MOTORS (FAMISEP) | ARATOR) | _N/A | | 734 | | 734 | | N/A |
| FLUSH WATTER CO | | | | 46.6 | | 46.6 | | VIA |
| | and 14 | | | | <u> </u> | | | ¥# |
| | • | | | | | <u>_</u> | | |
| | | | | | _ | · | - | · |
| | | | | | | | • ' | |
| | | | _ | | | | • | |
| • | TOTAL | 0 | ·_ 2 | 28.9/780 | 7.6) 228 | 91780 | ر) ا | 0 |
| | | MATT (BTU/ | HR) | MATT (BTU/H | | T (BTU/HR) | | (BTU/HR) |
| • | | • | • | | | , ,,,,,,,, | | , Aerojina) |
| | | • | | • | | • • • | | |
| • | | | | . • | | | 7 | • |
| | | • | | • | • | • | | |
| | | | | | | - | | |
| | | | | | | : | | • |
| | | QPERAI | ISMVF | ERRAL. | 1185 | • | | |
| .• | | THE | aw, | P | | | • | |
| £6uerr | | T LEAK | TO COOLAN (BTU/HR/CYC | T . | CTRICAL | WE IGHT | | COLUME |
| SOURCE | (BIU/HR | /CYCLE) | (BIU/NK/CYC | LEJ (PK N | ATTS/CYCLE) | (LB/HISSIC | m) (f1 | /MISSIGN) |
| - N/A - | | | | ' | | • | | |
| | | . | | | | | | |
| | | | | | | | | <u></u> |
| | | | | | | | | |
| | | , | | | | | | |
| | | | | | | | | |
| | | , | | | ********** | | | · —————— |
| | | | | | | | | |
| . 10 | DTAL | iš/cy. ··· | **** | | | ********** | | |
| A | MA() | はないでいい。 とないでいいで | MATTS/CYCI (BTU/HR/CYC | | | KG/MISSIO (LB/MISSIO | m #1, | (M12210#) |
| | (2.0) | | (B10/PE/C1) | | • | (CB\u(13>10 | (41. | \u122!mi) |

MATTS/CYCLE (BTU/HR/CYCLE)

1/5

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED) CONCEPT Z/CCHIMODE URINAL INDEX NUMBER 2.1.2 NEIGHT/YOLUME REQUIREMENTS WEIGHT (LBS) VOLUME (FT3) COMPONENT UKINIL COMPONIATS (201) 17.5 TOTAL KG (LBS) M3 (FT3) M I/N O F <u> 50LlD</u> EXPENDABLE VOL/UNIT (REF)
(PKG.VOL/UNIT) (REF)
(FT3) WT/UNIT (REF)
(PKG.WT/UNIT)(REF) TYPE UNITS/CYCLE(REF) YOTAL WT/CYCLE -TOTAL VOLVENCELE TOTAL MT. EVELES/DAY DAYS/MISSION X YOY.NIT/CYCLE (LB) CYCLLS/DAY ---- X -DAYS/HISSION X 6 A S/L 1 Q U 1 P EXPENDABLES REQUIREMENTS AMT.RECOVERED/CYCLE RECOVERY AMT.USED/CYCLE(REF) FACTOR .33 (207) FLUSH WATER 1-.0185 PRETRIMENT 1-.0185 Σ0 __342__ $\Sigma \odot$ _0113 42 1 184 1 01/8 - 191.19 . 342 - 41.52 (91.5)

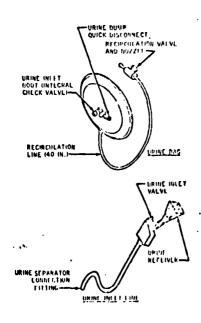
EVELEYDAY 1 DAYS/HISSION 10TAL TOSTICYCLE (LB) & (D)

D2-118561 4

| SPACECRAFT Space Station | | |
|---|-------------------|-------------------------------|
| HABITABILITY SUBSYSTEM Personal Hygiene | | Waste Collection/ Transfer |
| APPLIANCE FUNCTION Urine Collection/ | Transfer , | |
| APPL ANCE CONCEPT NO./TITLE 3/Intimate | Male Adapter | |
| INDEX NO. 2.1.2.3 | REF. NO. 283, 250 | |

DESCRIPTION

The intimate male adapter concept consists of a ..all_mounted unit similar to the unit used for the Skylab fecal/urine collector system. The adapter can be used when seated or in a standing position. Air entrainment is used to provide a substitute for gravity collection. The cabin air used for entrainment is filtered and recirculated back into the cabin. One wipe per cycle was assumed to be used because of splashback during urination. The flushing and operating time are the same as for Concepts 1 and 2. The flush water used was assumed to be 0.33 pound per flush. The second aperture unit pictured below uses an iris-type seal for the penis to prevent cabin contamination. The unit is designed to minimize spashback using a splash retarder. This unit operates the same as the Skylab unit.



ýs ·

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT 3/11/11/11/11 MALC NONPICK

INDEX NUMBER 2.1.Z. 3

| SOURCE | HE/ (BTU/H | THERMAL" | TO LJOLANT TU/HR/CYCLE) | ELECTRICAL (PK WATTS/C | . WEIGH | | VOLUME (FT³/MISSION |
|--|--------------------|--|----------------------------|----------------------------|--------------------------|------------------|---------------------------|
| · · . | | <u> </u> | NAL <u>PE</u> | N A L T 1 E S | <u>-</u> | | • |
| | | • | | | • | | |
| , · · · | TOTAL | WATT (BTU/HR) | 2 <u>28.9</u> WATT (| (780.6) (BTU/HR) | 2289 (78 WATT (BTU/HR | _ | O MATT (BTU/HR |
| | · · | | <u> </u> | | | <u> </u> | |
| GUSH WATER CO | OLDWK! | _ <i>N/A</i> | | 76.6 | 46.0 | <u>e</u> - | |
| MOTORS (FANS ÉS L | | | | 34 | 734 | | NA |
| SOURCE | | LATENT (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | TO COOLANT (BTU/HR) |
| | | IHERMAL. | <u>R E Q U I B</u> | REMENIS | | | |
| ٠. | | | · | | • | , , | • |
| | | 226 MAXINUM . | | TOTAL | 18 maximum | | TOTA |
| | | | • | 1.37 | | • | |
| | | | | | | | |
| NOTOR VALVE | | | <u>4</u> | | - Z | | .03 |
| PINE PUDIP OLENOID VIXVES(2) | .0125 | _15_ | 10 | | 16 | 16 | |
| MPONENT (REF) U <u>R FANS(PARATOR (</u> A | (HR) 19) - 0125 | (WATTS) | (WATTS) | ①×① 1.25 | (WATTS) | (WATTS) | ①x(|
| | USE TIME CYCLE | ② PEAK | ③ AVERAGE | Q) DEMAND (WATT-HR/ CYCLE) | ⑤ PEAK | 6 AVERAGE | DEMĂÍ (WATT-I CYCLE |
| | (1) | AC. POWER REQUIREMENTS AC. POWER (4) | | | | | _ (/) |

TOTAL

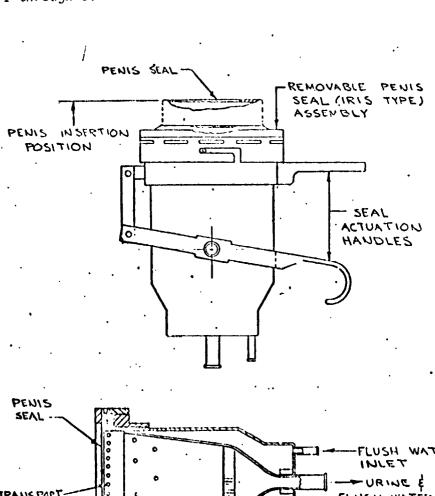
WATTS/CYCLE (BTU/HR/CYCLE) WATTS/CYCLE (BTU/HR/CYCLE) KG/MISSION (LB/MISSION) M³/MISSION (FT³/MISSION)

| CONCEPT_3/_[N]/////////////////////////////////// | | REMENTS AND PENALTIES CA | ALCULATIONS (CONCLUDED) INDEX NU | MBER 2.1.2.7 |
|---|---------------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| | EXXED WEIG | HIVOLUME RE | QUIREMENIS | |
| CONDONENT | (REF) | WEIGHT (LBS) | | VOLUME . (FT³) |
| COMPONENT UCINIC | (RET) (DIA(DXIC) | 2.8 | | 0058 |
| CONTRONENTS | (MASDIK) | 40.0 | | 1.212 |
| DILY WIPES | (250) | 80.4 | | 5.09 |
| B. Colland V. Marian | · · · · · · · · · · · · · · · · · · · | | | |
| | | | • | |
| | | | | |
| | · | | · | |
| | | | | |
| , | | | | |
| | | , | | |
| | TOTAL · | | 3.2) | 178 (6.31) |
| | • • • | KG (LBS) | | M ₃ (FT ₃) |
| <u>s</u> <u>o</u> | LID EXPENDA | BLE WI/YOL ② 3 | REQUIREMENTS | <i>,</i> (§ |
| | | IIT (REF) WT/CYG | CLE VOL/UNIT (REF) | VOL/CYCLE |
| TYPE UNI | TS/CYCLE(REF) | /UNIT)(REF) ① X ((LB) (LB) | (FT ³) | EF) ① X (4) |
| DIZY WIPES | 1 2.04 | (196 (25) .010 | 129/196 (| 50).00C66_ |
| APEKTURE SERS | 1 -00 | 0000 000 | 26 | NEG |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | 0 000// |
| | · | Σ 3 _010; | CYCLE | TOTAL VOL/CYCLE |
| | | . (LB) |) | , (FT ³) |
| TOTAL WT. 42 | x 184 | x .0106 | 6 37 | 7.4 (82.4) |
| CYCLES/DA | DAYS/MISSI | ON TOT.WT/CYCL | | KG (LB) |
| TOTAL VOL | 101 | | | |
| MISSION 42 | IV XX DAYS/MISSI | x x | 6 | 144 (5.09) |
| CYCLES/DA | d nylotataa | ON 101.VOL/CYC | | r (11) |
| • | • | • | • | • |
| c | AS/LIQUID EX | CPENDABLES ! | REQUIREMENTS | |
| * | DAFTARTE FR | | _ | • |
| | . • | . ② -, RECOVERY | AMT.RECOVERED/CYCLE | AMT LOST/CYCLE |
| TYPE | AMT.USED/CYCLE(REF | FACTOR | ①x② (LB) | , (LB) |
| FLUSH WARTE | .33 120 | | 324 | .006 |
| PREPLATMENT | | | | |
| CHEMICAL | | 9) 10185 | 0117: | .0058 |
| | | | | |
| | | | | |
| | 4 | | | |
| Σ. | 1342_ | · · | Σ © | .0118 |
| | <u> </u> | • . | | |
| TOTAL NT. 42 | x 184 | | 91.2 + .342 | 41.5 (91.5) |
| THIS STON - 42 | DAYS/MISSION | YOYAL LOSIZEVELE | ALD A | KG (LB) |

| l | <pre>Space Station ITY SUBSYSTEM Persons</pre> | al Hygiene MABITABILITY | runction | Waste Collection/ Transfer |
|-----------|--|-------------------------|-----------|-------------------------------|
| | FUNCTION Urine Co | • | • | |
| APPLIARCE | CONCEPT NO./TITLE_ | 4/Aperture Urinal | | |
| INDEX NO. | 2.1.2.4 | REF. NO. | 236, 273, | 209, 207 |
| | | • | | |

DESCRIPTION

The aperture urinal concept consists of an aperture and centrifugal separator. Urine is collected as described in the previous concepts. The study assumed 0.33 pound of flush water per cycle. The operating time is the same as Concepts 1 through 3.



دائم

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS INDEX NUMBER 2.1.2.1. CONCEPT 4 MECRIURE URINAL ELECTRICAL POWER REQUIREMENTS POWER POWER (4) DEMAND (7) DEMAND (WATT-HR/ USE TIME 2 (3) (5) 6 (WATT-HR/ CYCLE PEAK AVERAGE AVERAGE PEAK CYCLE) CYCLF) COMPONENT (HR) (WATTS) (REF) (WATTS) ①x① (WATTS) (WATTS) AIR FAN/SUPA AIR(02) .0125 1.25 200 100 UPINC POMP -0125 10 SOLLINGID VOLVE MEMONING CONTROLLER/IMER -017 1.37 .034 MAXIMUM . TOTAL MAXIMUM TOTAL THERMAL REQUIREMENTS TO COOLANT LATENT SENSIBLE HEAT LEAK SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) MOTORS (FAMES PARATOR) 734 FLUSH WATER 2239 (7906) 228.0 (780.6) TOTAL WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) OPERATIONAL PENALTIES THERMAL'
TO COOLANT
(BTU/HR/CYCLE) ELECTRICAL VOLUME WEIGHT HEAT LEAK SOURCE (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT3/MISSION)

WATTS/CYCLE

(BTU/HR/CYCLE)

KG/MISSION (LB/HISSION) M³/MISSION) (FT³/MISSION)

TOTAL

WATTS/CYCLE (BTU/HR/CYCLE) APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

ONCEPT 4/10/24/086- URINIC INDEX NUMBER 2-1-2.

| TOTAL 356.3 (42.3) KG (LBS) FACTOR KG (LBS) KG (LBS | POHENT PUNIN SECUMPONE | (REF) | WEIGHT (LBS) 42.3 | UIREMENIS | VOLUME (FT ³) .3.15 |
|--|---------------------------|--|--|---------------------------------|---------------------------------------|
| TOTAL WY/CYCLE (LB) TOTAL WY/CYCLE (LB) TOTAL WY/CYCLE (FT3) TOTAL WY/CYCLE (FT3) TOTAL WY/CYCLE (FT3) TOTAL WY/CYCLE (KG (LB) KG (LB) WG (LB) FOUR TOTAL WY/CYCLE (LB) WG (LB) | TYPE UNIT | 1 D | . KG (LBS) . L E <u>M T/V Q L</u> R 2) | EQUIREMENTS VOL/UNIT (REF | M ³ (FT ³) |
| CYCLES/DAY DAYS/MISSION TOT.VOL/CYCLE (FT3) GAS/LIQUID EXPENDABLES REQUIREMENTS O ANT.RECOVERY (D) (D-(3) (LB) FACTOR (LB) CUSH WATCH ANT.DSD/CYCLE (LB) FACTOR (LB) CUSH WATCH ANT.DSD/CYCLE (LB) FACTOR (LB) CUSH WATCH COSC CIRCUITMENT | | DAYS/MISSTON | TOTAL WI/CY (LB) | Σ | 101AL VOL/CYCLE |
| | <u>G</u> <u>A</u> | S/L 1 Q U 1 D E X P O AMT. USED/CYCLE (REF) (LB) | TOT.VOLZCYCLE (FT3) ENDABLES RE RECOVERY FACTOR | AMT.RECOVEPED/CYCLE O X ② (LB) | AMT LOST/CYCLE (1)-(3) (LB) |

| 4.0 | | |
|-------------|---|--------|
| 9 2. | + | |
| 3 | 1 | HABITA |
| | 1 | HADLIA |

| SPACECRAIT Space Station | Waste Collection |
|---|---------------------------------------|
| HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION | · · · · · · · · · · · · · · · · · · · |
| APPLIANCE FUNCTION Urine Collection/Transfer . | |
| APPLIANCE CONCEPT NO./TITLE 5/Liquid/Gas Flow Cuff-Type (Apo | 110) |
| INDEX NO. 2.1.2.5 REF. NO. Rockwell Dwg | . SEB14000010-303 |
| | |

DESCRIPTION

The liquid/gas flow cuff-type concept is the system used on Apollo. A cuff is utilized which fits snuggly to the penis. Urine transfer was accommodated on Apollo using a vacuum; however, a centrifugal separator could also be utilized. The concept presented assumes vacuum transfer since the intimate male adapter (Concept 3) is similar and uses air entrainment. The operating time was assumed to be 1.75 minute using a 45 second urination time. Filter change was considered for this concept due to the frequent changeout required (one per 14.3 man-days).

RECIRCULATION LINE
CONNECTION (CONNECTS
TO RECIRCULATION
LINE NOZZLE)

| | EFFC | î r i c ș i | POWER | REQUIRE | HENIS | | |
|---|------------|---------------|-----------------|--------------|--|-------------|---|
| • | (5) | ^. | C P_O W E | R | D C | POWE | R |
| | USE TIPE | (2) | 3 | DEISAND | ⑤ | 6 | (7) Deman |
| | CYCLE | PEAK | AVEPAGE | (WATT-HR/ | PEAK | AVERAGE | (WALT-II |
| COMPONENT (REF) | (HR) | (WATTS) | (WAITS) | (1) x (3) | (WATES) | (WATIS) | CYCLE) |
| <i>1.</i> 1. | | | | , | | | • |
| | | **** | | | | | |
| , | | | | -, | | | |
| | | | | | • | | |
| | | | | | an an drawn december or comment | | |
| reflected attended to distinguish on the series of the state of the | | | | | | | . |
| | | | | | . + | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| • | | MUMIXAM | | TOTAL | MAXIMUM | | TOTAL |
| · | | | | | | • | |
| | | • | | | | • | |
| | | | | | | • | |
| | | • | | | | | |
| | | THERMAL | REQUI | REMENTS | | | |
| | - | | | | | | |
| | | LATENT | | SIBLE | HEAT LEAK | | COOLANT |
| SOURCE | | (BTU/HR) | (BT | U/HR) | (BTU/HR) | (| BTU/HR) |
| 11/2 | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | • | | | |
| | | | | | | | |
| | | | - - | | | - | |
| | | | | | | | |
| | | | | | | | |
| 1 | OTAL | | | | and the second s | | |
| | | WATT (BTU/HR) | WATT (| (BTU/HR) | WATT (BTU/HR) | WAT | T (BTU/HR) |
| , | | | | | | | |
| • | | | | | | | |
| ORIGINAL PAGE | 18 | | | • | | | |
| OF POOR QUALIT | Yi | • | | | | | |
| · dording | •' | | | | | | |
| | g | <u> </u> | <u>NAL PE</u> | NALTIES | | | |
| | | THERMAL | | | | | |
| , | | T LFAK T | O COOLANT | ELECTRICAL | WEIGHT | | VOLUME |
| SOURCE | (BTU/IIR | /CYCLE) (BT | U/HR/CYCLE' | (PK WATTS/CY | CLE) (LB/MISSI | ON) (FT | 3/MISSION |
| N/: | | | | | • | | |
| | | | | | | | - |
| | | | | | | | |
| | | | <u> </u> | | | | |
| | | | | | | | |
| | | | | | | | |
| | | · | | | | | |
| _ | | | | • | | | |
| T01 | | | | | KG/MISSI (LB/MISSI | | /MISSION |
| | | IS/CYCLE W | ATTS/CYCLE | | | | |

APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS (CONCLUDED) CONCEPT 5/LIGUIP/ 115 FLOW CUFF TYPE (APOLLO) INDEX NUMBER 2.1.2 . 1. REQUIREMENTS WEIGHT/YOLUME COMPONENT (REF) (FT3) WEINE RUCKTACIL (SUBILICADIO) FILTER HOUSING FILTUR PACKING 149 & CRINE HOSE TOTAL .172 (6.663 M3 (FT3) KG (LBS) WI/VOL REQUIREMENTS EXPENDABLE VOL/UNIT (REF) (PKG.YOL/UNIT)(REF) (FT3) WT/UNIT (REF) (PKG.WT/UNIT)(REF) (LB) TYPE UNITS/CYCLE(REF) .00166 25 FILTURS GAS/LIQUID REQUIREMENTS EXPENDABLES AMT. RECOVERED/CYCLE ANT LOST CYCLE 0 RECOVERY AMT.USED/CYCLE(REF) **FACTOR** TYPE (LB) OXYGEN $\Sigma \odot -997$ Σ

947 TOTAL 1 057/CYCLE (LB)

· 7320 · 947 · 33204(73204)

D2-118561 A

| HABITABILITY SUBSYSTEM 2.0 | Personal Hygiene |
|------------------------------|-----------------------------|
| HABITABILITY FUNCTION 2.1 | Waste Collection/Transfer |
| APPLIANCE FUNCTION 2.1.3 | Vomitus Collection/Transfer |
| NUMBER OF CONCEPTS CONSIDERE | D4 |

ASSUMPTIONS

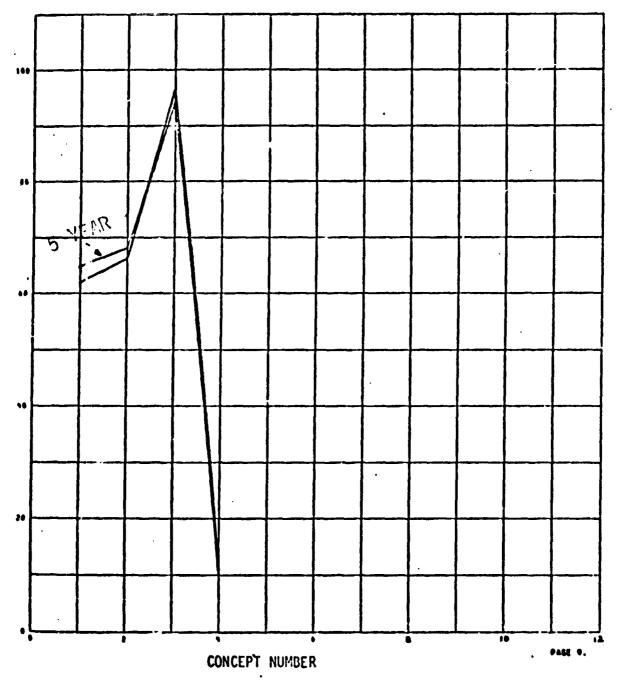
- (1) The vomitus collection/transfer concept considered portable and fixed methods. The collection devices used in conjunction with the fecal collector or waste disposal unit were considered fixed. The fixed method is not the most ideal since a sick crewman may not always be able to reach the collection device prior to vomiting. Fixed methods, however, were considered for the purpose of comparison.
- (2) The study assumed .84 cycles per day for Space Station and .56 cycles per day for Shuttle. The concept use time required per cycle is dependent on the concept type.
- (3) Filter weight and volume were included if a high replacement frequency is required. Periodic filter replacement was not included in the study.
- (4) Flush water, if required, for a vomitus collection concept was assumed not recoverable since the used flush water would normally be dumped into the fecal collector.

C

| TYPE USED FLOW PRESS TEN (0) -46/USE (0) (75/G) (DEG (18/USE) (0) (75/G) (DEG | THERMAL REGNTS | ELEC PRR REGHTS | WI, VOL REGHTS | DEVELOPHENT | RESUPPLY |
|---|---|--|---|---|---------------------------------------|
| 230 (2184) (e) | COLANT HT LEAK | PK PRR AVG PRR | METCHT VOLUME | AVAIL INDEX | # # # # # # # # # # # # # # # # # # # |
| | | ************************************** | 1KG+ CU Mt (LBS) (CU FT) | | - K G + (L B S) |
| -001 (-01 , 70-01 | 0 0 0 0 | 000 | 10.31 (3.48) | 2 25 | |
| 8 -1-0 | | 0. | 100 | 2 25 | |
| | .00 | 0.0 | - - | 0 | (2:51 |
| | 50 | 160.0 | - | 30. | 35.0 |
| APPLIANCE CONCEPT NO. CONCEPT NAME | | (*) 1 - CABIN AIR 2 - CABIN AIR 3 - OXYGEN 3 - OXYGEN | (CIRCULATED), (LOST) , (LOST) , (LOST) , (LOST) | LITERS/SEC (FT ³ /V13) KS/H2 (LS, H3) KG/H3 (LE,F7) KG/H3 (LE,F7) | - (k |
| 1 • INTIMATE PERSONAL ADAPTOR, DISPOSABLE UNITES BITH CONN. 2 • INTIMATE PERSONAL ADAPTOR, DISPOSABLE (NATES BITH CONN. 3 • PONT, MALE DISPOSABLE COLLECTOR (TYPE USE CONNERCIALLY). 4 • REJSABLE PORTABLE COLLECTOR. | BITH COMPOSED BITH COMPOSED ERCIALLY! | 5 - WIES 6 - WIESSEN 7 - WIESSEN 8 - FRECT 9 - WATER | (LISTULATED); (LOST) (CIRCULATED); (CIRCULATED); (PROCESSED); | K5/F3 (LE/F2) K5/F3 (LE/F2) K5/F3 (LE/F3) K5/F3 (LE/F3) K5/F8 (LE/F3) | |
| ORIGI OF Po | | (**)AVAILABLE | č | 11/01CATOR 0-25% | |
| IVAL PAI | | | rt Trequired Required | 25-50X 50-75X 75-100X | |

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - INTIMATE PERSONAL ADAPTOR, DISPOSABLE (MATES WITH COMMODE)
2 - INTIMATE PERSONAL ADAPTOR, DISPOSABLE (MATES WITH COMMODE)
3 - PORTABLE DISPOSABLE COLLECTOR ITYPE USE COMMERCIALLY)
4 - REUSABLE PORTABLE COLLECTOR



Vomitu Collection/Transfer (Space Station)
Concept Trade

| NO 180 COLLECTIO [®] /TRAMSFER (SPACE STATION) | |
|--|--|
| 75) (18/87UM) -05 (18/87UM) -12 7:30 - VOM 7US | |
| 180.0 (.ev YEARS) 6 OIRECT TO COOLANT CABIN NEAT LEAK ZWATJJ TYPE 1 AZ NATRIK | ### 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| NUMBER OF CATS = 180.0 (.ee TEA USES NOO SUBROUTINE 6 THERNAL PENALTY = OIRECT TO COOLA THERNAL PENALTY = CABIN MEAT LEAK POREM PENALTY GLASSMATTI TYPE I | # # # # # # # # # # # # # # # # # # # |

| SINGLE SCLECTION PARAMETER RESONAND PAGE SINGLE SCLECTION PARAMETER RESONAND PAGE 6.1.8. 64.11 % 4.6.4. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.12 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.13 % 6.4.6. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.11 % 6.4.6. 13.11 6.1.8. 64.10 % 6. | | | | | ORIGIO OF PO | AL PAGI | | | | | | |
|--|---------------------|--|--------|--|---|---------------------|---|---------|-----------------|-------------|-------------------|--|
| 100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | SENSITIVITY ANALYSI | SELECTION FARMETER WEIGHING FACTOR BY 50 (BASED ON 100 S MAK POINIS) | CONCEP | . 15 . 66 . 11 . 96 . 46 . 35 . 37 . 35 . 37 . 38 . 37 | 65.00 64.02 46.77 58.18 64.18 96.44 65.00 69.02 96.74 | 57.75 61.677 -11.99 | EACH CONCEPT AFTER INCREASING PARAMETER BEIGHTING FACTOR BY | 2 3 4 4 | 62-61 96-10 | 62-61 96-10 | 66.49 71.23 96.10 | |

| | | | | | | D2 | | 501 4 | 1 | | |
|-----|---|-------------------------------------|-------------|--------------|--|---------------------------|---------------|-------|---|--|--|
| | | 0 | | | | | | | | | |
| · . | | COLLECTION/TRANSFER (SPACE STATION) | ONCEPT | 6h*5 | 000 | 000 | | | | | |
| | UH) .0540 | ! ! | 2 3 6 | 15.00 1 | 15.00 15.0 5.00 5.0 | 2.50 15.00 11.75 12.05 | 68.04 93.92 | | | | |
| | (5.00 YEARS) TO COOLANT (LB/BTUH) HEAT LEAK (LB/BTUH) TYPE 1 21100 | (0) 12 5 275) | 1 214 | 1 1 | 15-15-00 | 1 | 6407 | | | | |
| | 1826.0 (5.00) INE | MATRIX • | MAX | 177.50 | | | | | | | |
| | NUMBER OF DAYS - 1826.0 (5.00 YEARS) USES HOD SUBROUTINE - THERMAL PENALTY - DIRECT TO COOLANI THERMAL PENALTY - CABIN HEAT LEAK POWER PENALTY (1885/HAIT) TYPE 1 | SELECTION | ACTOR VALUE | PONER .00000 | VOLURE 13700 THERMAL 000000 RTLIAB-Y 99972 | DEV COST 163. | #41146 .00000 | | | | |

| SENSITIVITY ANALYSIS | |
|---|---|
| ATING FOR EACH CONCEPT AFTER INCREASING | |
| | |
| 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | |
| 2.01 2.004 | |
| 94.36 19.2 | |
| 94.36 10.2 | |
| i | |
| 2.93 10.2 | • |
| | D.2.1 |
| IVITY ANALYS | |
| CONCEPT ETER WEI | |
| • | |
| | , the control of the |
| .04 93.92 81.04 | |
| 94.79 | |
| 93.79 | |
| 67-18 93-75 11-34 69-88 93-75 8-64 | |
| 95.08 | |
| | |
| | |
| | |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

| 쫎 |
|--------------|
| ION/TRANSFI |
| S COLLECTIO |
| 2.1.3-VOMITU |
| FUNCTION: |
| APPLIANCE |

| BER OF COMPONENTS | | 0000000000 | | | | | | | | | | | |
|-------------------|----------------|----------------|--|---|-------------------------------|-----------------------------|------|------------------------|----------|------|---------------------------------------|-----------------|---|
| NUN | | 0 | | | | • | | | | | | | |
| | UAL VE | S WAL' | • | ı | • | - | | | | | | | _ |
| | | 8F0 | ı | • | , | | | .,, . , | <u>.</u> | | · · · · · · · · · · · · · · · · · · · | | |
| | COMPONENT TYPE | APPLIANCE TYPE | INTIMATE PERSONAL ADAPTER, DISPOSABLE (MATES WITH COMMODE) | INTIMATE PERSONAL ADAPTER, LINED, REUSABLE (MATES WITH COMMODE) | PORTABLE DISPOSABLE COLLECTOR | REUSABLE PORTABLE COLLECTOR | | | | | | | |

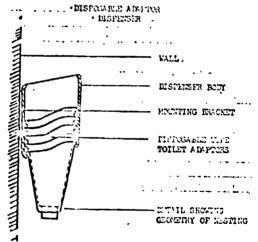
D2:1185(1-4

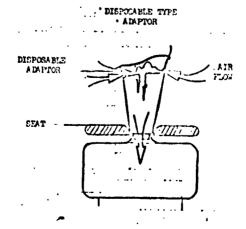
| SPACECRAFT Space Station | • |
|---|---|
| HABITABILITY SUBSYSTEM Personal Hygiene | Waste Collection/ HABITABILITY FUNCTION Transfer |
| APPLIANCE FUNCTION Vomitus Collection/Tr | ransfer |
| APPLIANCE CONCEPT NO./TITLE 1/Intimate | |
| INDEX NO. 2.1.3.1 | REF. NO. 209,186,187,236, & 207 |
| DESCRIPTION The intimate personal dispos | sable adapter concept is made of |
| | ed to interface with the feces collection |
| tube of a commode. The adapter blocks the | |
| in the top of the unit provide the air in | nlet for voin tus entrainment. The top |

in the top of the unit provide the air inlet for vointus entrainment. The top of the unit is formed to a crewman's face affecting a seal over the nose, around the mouth, and under the chin. All vomitus material is expelled directly into the feces collection unit. After use, the adapter is removed and processed in the feces collector. A dispenser for storage of clean vomitus adapters is located near the feces collector.

DISPONDED AMPITOR

MISTERISER





T

D2-1185CL-1

| | ĒļĘCI | TRICAL I | POWER | REQUIRE | H L H L S | | |
|--|----------------|--|----------------|-------------------------------|--|-------------------------------|--------------------------|
| | (i) | Λ. | PONE | R | D_ | C POWF | R |
| | CACFE Tries | (2) PEAK | (3) AVERAGE | (4) DEDA (D) (WATT HR/ CYCLE) | (5) PEAK | (6) Average | (/) H-11AN) (110Y) |
| OMPONENT (REF) | (HR) | (WATTS) | (WATES) | (DX(J) | (WATTS) | (WATTS) | CYCIT) |
| | | | | | | | |
| | • | | | - | , | | |
| | | | | | , | | |
| | | | | | | | |
| The same of the sa | | | | | | | |
| the transmission of the street | | | | | " auto-drain-de-had more, y | Committee than the control of | |
| | | MAXIIIUM | | TOTAL | MAXIMUM | | TOTAL |
| | | | | | | | |
| | | <u>THERMAL</u> | REQUIR | EMENTS | | | |
| | • | • | | | UCAT 1 CAV | *** | COOL BUT |
| SOURCE | | LATENT (BTU/HR) | SENS (BTU | | HEAT LEAK (BTU/HR) | | COOLANT TU/HR) |
| | | | | | | | |
| | | | • | | | | |
| TO BE A CONTRACTOR OF BEING A STATE OF THE S | | | • | | Street and Street Stree | | |
| | | | | | | | |
| The second day to the second second second second | | | - | | | | |
| | TOTAL | | | | | | |
| • | TOTAL | WATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT | (BTU/HR) |
| • | | • | | | | | |
| • | | | | • | | | |
| | | , | | | | | |
| • | <u>0</u> | PERATION | LAL PE | NALIIES | | | |
| • | HEAT | THERMAL TO | COOLANT | ELECTRICAL | WE I GH | | OLUME |
| SOURCE | (BTU/IIR) | CYCLE) (BTU | /HR/CYCLE) | (PK WATTS/CYC | LE) (LB/MISS | ION) (FT' | /MISSION) |
| <u> </u> | | | | | , | | |
| | | | | | | | |
| | | | | | | | - |
| gan de santa de la composition de la composition de la composition de la composition de la composition de la c La composition de la composition de la composition de la composition de la composition de la composition de la | | *** * *** **************************** | | | | | |
| 71 | DTAL | | • | | • | | • |
| • | VATI | S/CYCLE WA | 114/CALLE | | KG/M1551 | | 415510N |

(_)

APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

CONCEPT // //////////// PCP-SIMCNOPPRE, LISPENSALE

INDEX

/5

INDEX NUMBER 2.1.3.

| COMPONENT | (REF) | | WEIGHT (LBS) | | | VOLUME (FT3) |
|------------------------|--------------------------|------------------------------|--------------------------|---------------------------------|--|--|
| DISPUNSUE ADIPUGAS | (126) (136 |) _ | 3.75 15.5 | 5 | | 1.32 |
| | • | | | | | |
| | | | | | • | |
| | | _ | | | | |
| | | | | | , | |
| | TOTAL . | . [| 8.7 (/ | 9.25) | .09 | 18 (3.48) H ³ (FT ³) |
| • | <u>SOLID</u> <u>EXP</u> | <u>E N D A B</u> | LE WIVEL | | REMENTS | |
| TYPE ADNPTERS | UNITS/CYCLE(REF) | WT/UNIT (PKG.WT/UN (LE | 11)(REF) (1 | ③ /CYCLE /LB) / | VOL/UNIT (REF) (PKG.VOL/UNIT)(REF) (FT3) - 0/2 | \$ \text{VOL/CYCLE} \(\text{(FT}^3 \) \(\text{COLL} 7.7 \) |
| | | | | - | | |
| 1 | | | | | | |
| | | | | - | | |
| | | | Σ3 - 101AL | | Σ⑤ | .0//77 TOTAL VOL/CYCLE |
| TOTAL MT CYC | 84 x DA | 184 VS/MISSION | XX | CYCLE) | 7.0 | kg (LB) (15.5) |
| TOTAL VOL MISSION CYC | 34 x x DA | 184 VS/M15510N | x 0// 101.VOL/ (FT | | .05 | 2 (1.82) No (F17) |
| | <u>G A S/L 1 Q U 1 D</u> | EXP | ENDABLES | <u>R E Q U I R</u> | EMENIS | • |
| • , • , | | D | RECOVERY | AMT.RE | ONTERED/CYCLE | AMT LOST/CYCLE |
| - N/A - | AMT.USED/C | YCLE(REF) B) | FACTOR | | ① x ② (LB) | , O(LB) |
| | | | | | • | |
| | Σψ | | • | | Σ@. | |

C2-205

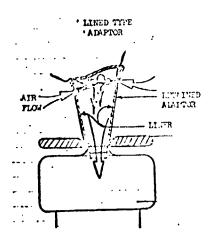
(LB)

/z (1)

TOYALTI OSY/CYCLE

D2 1185(1-4)

| SPACECRAFT Space Station Waste Collection/ |
|--|
| HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer |
| APPLIANCE FUNCTION Vomitus Collection/Transfer |
| APPLIANCE CONCEPT NO./TITLE 2/Intimate Personal Adapter, Lined, Reusable (mates with commode) |
| INDEX NO. 2.1.3.2 REF. NO. 187,250, & 207 |
| of metal with provision for attachment of a plastic or paper liner on the inside surface. The adapter is shaped to interface with the feces collector transfer tube. The liner and adapter are provided with holes to allow cabin air into the adapter for vomitus entrainment. The liner is deposited into the feces collector after usage. The adapter is cleaned to maintain hygienic acceptability and stored near the feces collector. One biocide wipe and one dry wipe were assumed to be adequate to clean the reusable liner. Skylab wipe data were used to determine the wipes penalty. The reusable adapter is identical to the Loncept 1 config- |



| | EFFC | TRICAL | P Q W <u>E R</u> | BE ONTE | | | |
|--|-------------|---|------------------|-------------------------------|-----------------------|----------------|----------------------|
| | (1) | ^ | C <u>POWE</u> | R(4) | <u> </u> | <u>crowr</u> . | R |
| | nze jine | ② | (3) | DE MAND | (5) | <u>(6)</u> | DEN |
| | CYCLE | PEAK | AVERAGE | (WATT-HR/ CYCLE) (DX(1) | PEAK | AVERAGE | (WATT CYCE (1) |
| COMPONENT (REF) | (Hk) | (WATIS) | (VATTS) | $\mathbf{O}^{\mathbf{x}(0)}$ | (WATTS) | (WATTS) | (I)) |
| | | - | | | | | |
| - | | an and a second | | - | | | |
| | | - | | | | | |
| | | | | | | | |
| | | | | | | topage 4-16 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| , | | MUMIXAM | | TOTAL | MAXIMUM | | TO |
| | • | • | · | | | | |
| | | IHERMAL | REQUIE | EMENTS | | | |
| | • | | | | | | |
| SOURCE | • | LATENT (BTU/HR) | SENS (BTU | | HEAT LEAK (BTU/HR) | | COOLAN TU/HR) |
| SOURCE . | • | | | | | | COOLANT TU/HR) |
| | • | | | | | | |
| | | | | | | | |
| | - | | | | | | |
| | | | | | | | |
| | | | | | | | |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOTAL | | | | | | |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOYAL | | (810 | | | (B | TU/HR) |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOTAL | (BTU/HR) | (810 | /HR) | (BTU/HR) | (B | TU/HR) |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOTAL | (BTU/HR) | (810 | /HR) | (BTU/HR) | (B | TU/HR) |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOTAL | (BTU/HR) | (810 | /HR) | (BTU/HR) | (B | TU/HR) |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | TOTAL | (BTU/HR) | (810 | /HR) | (BTU/HR) | (B | TU/HR) |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | | (BTU/HR) | WATT (| /HR) | (BTU/HR) | (B | TU/HR) |
| | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| NALTIES ELECTRICAL | WATT (BTU/HR) | (B | (BTU/I |
| ^/ <u>\text{\tint{\text{\text{\text{\text{\tint{\text{\tint{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\text{\text{\text{\text{\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\tin}\tint{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\tint{\text{\text{\text{\texi}\text{\text{\texit{\text{\ti}\text{\texit{\text{\text{\texi{\texi\}\tint{\text{\texi}\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\text{\text{\tex{</u> | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| BTU/HR) | WATT (BTU/HR) | (B | (BTU/I |
| | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| NALTIES ELECTRICAL | WATT (BTU/HR) | (B | (BTU/I |
| SOURCE | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| NALTIES ELECTRICAL | WATT (BTU/HR) | (B | (BTU/I |
| SOURCE | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| NALTIES ELECTRICAL | WATT (BTU/HR) | (B | (BTU/I |
| SOURCE | HEA | WATT (BTU/HR) O P E R A I I O I T LEAK THERMAL | WATT (| NALTIES ELECTRICAL | WATT (BTU/HR) | (B | (BTU/I |

WATTS/CYCLE (BTU/HR/CYCLE) (NOISSION)

KU/WI2210N (FB/WI2210N)

HATTS/CYCLE (BTU/HR/CYCLE) **52** 0000000

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

CONCEPT 2/141114016 P. P.SCHAL NORPICE, LINED, REUSABLE INDEX NUMBER 2.1.3.2

| COMPONENT | · (REF) | WEIGHT (LBS) | VOLUME (FT ³) |
|-------------|-----------------------|----------------------------------|---|
| DISPUNSER/L | | 1.161 | .956 |
| LINCES | (187) | 4.75 | .789 |
| WET/WY W | IPCS (250) | 1.2.35 | .591 |
| | | | • |
| | | | |
| | | | |
| | | | |
| | | | |
| | 70741 | 0.20 (10 | (1) |
| | T OTA! | 8.28 (18. | |
| | · | • KG (LBS) | M³ (FT°) |
| •. | SOLID EXP | ENDABLE WI/YOL B | REQUIREMENTS |
| | • | Ø 3 WT/UNIT (REF) WT/CYCLE | T VOL/UNIT (REF) VOL/CYCLE |
| TYPE | ① UNITS/CYCLE(REF) | (PKG.WT/UNIT)(REF) ①x② (LB) (LB) | (PKG.VOL/UNIT)(REF) (FX 4) (FT3) |
| LINERS | (187) | 0307.(181)0307 | |
| WET WIPES | 1 (250) | 3.4/70 (250) .0486 | 129/70 (250) .00/84 |
| DRY WIPES | • | 2.04/196(250) .0312 | 129/196 (250) .00/975 |
| | | | |
| | | | |
| | | | *************************************** |
| | • | Σ3 LLOS TOTAL HT/CY | Σ (5) 0089 |
| | • | (LB) | (FT3) |
| TOTAL WT. | 3 <i>4</i> x | YSA X | 7.75 (17.1) |
| CYC | LES, DAY DA | YS/MISSION TOT.WT/CYCLE (LB) | KG (LB) |
| TOTAL_VOL_ | 20 | | .039 (1.38) |
| | LES/DAY A DA | YS/MISSION X | |
| • | • | (FT ³) | |
| • | | | • • |
| • ., • | @ ¥ 2\r 1 0 n 1 D | | <u> QUIREMENIS</u> |
| | (| D RECOVERY | AMT.RECOVEPED/CYCLE AMT LOST/CYCLE |
| TYPE, | AMT.USED/C | YCLE(REF.) FACTOR | ΦxΦ΄ (LB) |
| N//) - | <u> </u> | | |
| | | | |
| | | | |
| | | | |
| | | | |
| • | Σ ① | • | Σ • |
| | | | • |
| TOTAL WT. | | • | [|

SPACECRAFT Space Station

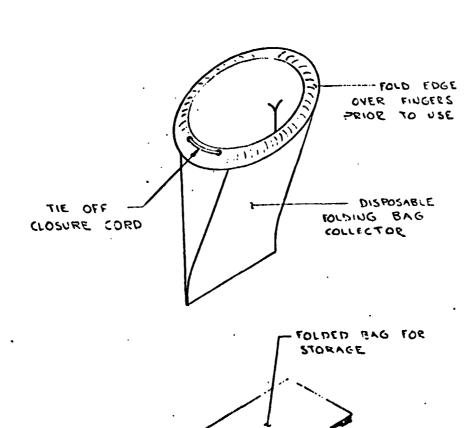
HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Transfer

APPLIANCE FUNCTION Vomitus Collection/Transfer

APPLIANCE CONCEPT NO./TITLE 3/Portable Disposable Collector (airline type)

INDEX NO. 2.1.3.3 REF. NO. 187,207,250, & 209

DESCRIPTION The portable disposable collector is a light flexible bag with a drawstring closure device. The bag is used on all airlines and is made of thin gage plastic. The crewman can store the bag in a clothes pocket where it will be ready for use at any time. The bag is unfolded and grasped near the opening by both hands and held against the face enclosing the nose and mouth. Proper placement of the bag against the face provides the seal. The bag is sealed after use by tying a knot in the closure cord and discarding the bag and contents into the feces collector.



直對

D2-1185(14.

| | | EFEC | <u>f</u> Ŗī ÇĄ L | POWER Ar no | | ŢŖĘŀ | I E N T S | P 0 | |
|--|---|-------------------|--|-------------------------------------|---------------------------|--------------|-------------------|-------------|----------------------------|
| COMPONENT | | CACTE TZA TIWE | PEAK (WATTS) | A_CP_0 (3) AVERAGE (WAITS) |) DET: WATT CYEL | -HP/ f) | (S) PEAK (WATTS) | (WATTS) | CILLE |
| 1/4 | | ., | | | _ ' | | r parting a relia | | |
| | | | | | | | | | |
| | | | | | | · , | | | |
| | | | *************************************** | | · | | | | |
| | | | | | | | | | |
| , | | | | | | | | | |
| | , | | MUNITIXAM | | 101 | AL. | MAXIMUM | | TOTAL |
| | | _ | | | | | | | |
| | | • | | B F O 11 | | u . . | | | |
| | | • | THERMAL | | IREME. | | HEAT LEAK | | TO COOLANT |
| SOURCE | . | | (BTU/HR) | | (BTU/HR) | | (BTU/HR) | | (BTU/HR) |
| | <u>/ : </u> | _ | | | , | | | | |
| | | | | | · | - | | | |
| n elizar da destruita elizar sporte destruita que el | | | | _ | | | | ·- • | |
| | | | | | | | | | |
| | 101 | AL | | | | | | | |
| | | | WATT (BTU/HR |) WA | TT (BIU/HR) | 7 | WATT (BTU/HR) | _ | WATT (BTU/HR) |
| | | | | | • | | | | |
| • | | | | | • | | | | |
| | | | • | | | | | | |
| | | ! | OPERATI | ONAL | PENALI | 155 | | | |
| • | | HEA | THERMAI T LEAK | L TO COOLANT | ELEC | TRICAL | WEIGHT | | VOLUME |
| Sourc | | (BTU/HR | (CACFE) | BTU/HR/CYCLE |) (PK WA | TTS/CYCL | .E) (LB/MISSI | ON) | (FT ³ /MISSION) |
| | <u> </u> | | | | | · | | | |
| · | | | | | ··· | | | | · |
| | | | ngjet-litte quantitatigny ng programme angletic angletic name | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

D2-1185C1-4

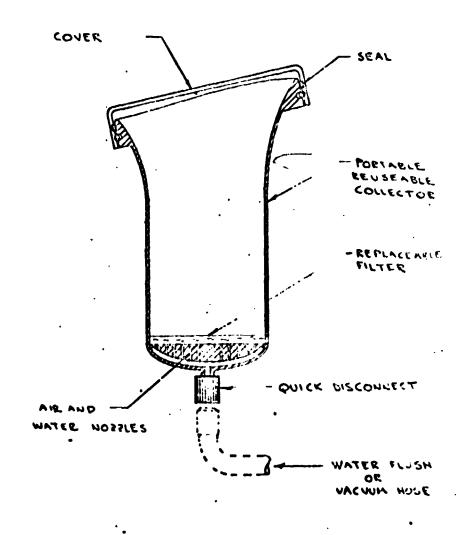
CONCEPT 3/100111611 DISPO: VIBLE COLUCIOR INDEX NUMBER 2.1.3.

| E.1.) IOMPONENT IOMETIBLE COLLECTOR'S | (REF) (202) | HIVOLUME REQU. WEIGHT (LBS) 15.46 | 1 R E M E M ½ S | VOLUME (513) |
|---|---|---|--|---|
| | | | | |
| | | | , | |
| | TOTAL · | 7.01 (15.46 KG (LBS) | <u>.</u> | 038 (.134) N ³ (FT ³) |
| SOLID TYPE UNITS/CYC PORTABLE COLLECTORS | ソ (PKG.WT | BLE W 7/Y OL RE (TO THE STATE OF THE STATE | QUIREMENIS VOL/UNIT (REF) (PKG. VOL/UNIT) (REF) (FT3) | (FT3) |
| OTAL WT 84 MISSION - VICLES/DAY | x 184 DAYS/MISSI | ∑③ | | 3 .000868 101AL VOL/CYCLE (F13) 7.01 (15.46) |
| OTAL VOLCYCLES/DAY | x | (LB) | | 03 <u>8</u> (134)] |
| • | 1QUID EX O NOT.USEC/C CLE(REF (LB) | Ø | MIREMENIS AMT.RECOVERED/CYCLE (LB) | AMT LOST/CYCLE O-() (LB) |
| ΣΦ | | | ΣΘ | |
| MISSION CYCER/BAY X | DAYSTRISSION 1 | YOYALTOST/CYCLE (LD) | | KG (Lb) |

| SPACECRAFT Space Station | The state of the s | Manda Callandia- |
|------------------------------|--|------------------------------|
| HABITABILITY SUBSYSTEM Perso | onal Hygiene HABITABILITY FUNCTION | Waste Collection Transfer |
| APPLIANCE FUNCTION Vomitus | Collection/Transfer | |
| APPLIANCE CONCEPT NO./TITLE_ | 4/Reusable Portable Collector | |
| INDEX NO. 2.1.3.4 | REF. NO. 207 | |

DESCRIPTION

The reusable portable collector is constructed of a lightweight metal (aluminum for study) canister type collector with a provision to draw cabin air through it during vomitus expulsion. The resulting entrainment will prevent cabin contamination. The vacuum provision makes sealing at the face less critical than other concepts. A sealing cover prevents spillage. The collector can be used at any vacuum source in the spacecraft. The collector is washed out in a feces collection commicde or other suitable debris trap by connecting a flexible flush hose to the collector.



D2-118561-4

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT 1/PEUSOBIC POLIBEC COLLECTOR

INDEX NUMBER 2.1.3.1

| | | RICAL | PON AC. | | REQUIRE R | D | C POW | |
|--------------------------------|--------------------------|------------------------|-----------------|-----------------|---|-----------------------|-----------------|----------------------------------|
| COMPONENT (REF) FAN ASSY (207) | USE TIME CYCLE (HR) .017 | PEAK (WATTS) 250 |) (N | O PERAGE HATTS) | DEMAND (WATT-HR/ CYCLE) (DX(D) | PEAK (HATTS) | AVEPAGE (WATTS) | (7) DEMANI (WATT-HI CYCLE) (X() |
| | | | | | | | | |
| | | 250 | | | 3.06 TOTAL | MAXIMUM | | TOTAL |
| | | <u>Lherh</u> ! | LL P | | REMENIS | | | - |
| SOURCE | • | LATENT (BTU/HR) | • | SEN: | SIBLE N/HR) | HEAT LEAK (BTU/HR) | | COOLANT |
| EAN ASSY | | N/A | | _8 | 52 | _852 | | N/A |
| 10 | DTAL . | NATT (BTU/ | HR) | | (852) BTU/HR) | 299.9 (O.) | | T (BTU/HF) |
| • | | • | | • | | · | | • |
| .• | | PERAI THE | MVT, | | MALIIES ELECTRICAL | WE I GH | • | VOLUME |
| = N/A = | HEAT (BTU/HR/ | LEAK CYCLE) | 10 COO (BTU/HR/ | LANT CYCLE) | (PK HATTS/CYC | | | YOLUNE 13/HISSION) |
| . 101/ | WATIS | /CYCLE | MATTS/(STU/HR) | | | KG/MISS (LB/MISS | ION M | /MISS.0N |

D2-118561-4

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

CONCEPT4/REUSABLE FORMBLE COLLECTOR

INDEX NUMBER 2-1.3. 11.

| COMPONENT | inent | HEIGH | WEIGHT | | VOLUME | |
|---------------------------|-------------------|-----------------------------|----------------------|----------------------|---|--------------------------------|
| COLLL CTOX | (REF) 2 · (207 | 1 | (LES) 2. Z | | (FT ³) | • |
| FILTUES | (201 | <u> </u> | 1.58 | 3 | .65 | |
| VALVE | (204) | _ | 4.00 | | .03 | |
| FAIL ASSY | | ′ | 10.00 | > | 75 | - |
| ********* | | _ | | | • | |
| | | _ | | | | |
| | | . – | ** | | 1 | |
| | | - | | • | | |
| | | _ | | | | |
| | TOTAL | ٠ | 8.07 (1 | 7.8) | .044 | (457) |
| | | • | KG (LBS) | | M3 (FT3) | |
| •. | SOLID EXP | <u>ENDAB</u> | LE MI/NOF | REQUIREM | | |
| | | WT/UNIT | | _ | | (CYCLE |
| | • | (PKG.WT/UN | IIT)(REF) (1) X | YCI E VOL /UN | IŤ (PEF) VOL /UNIT)(REF) (Î | Λ <u>ά</u> (ΓΕ Σχ ∰ Έ13) |
| TYPE <i>FILTURS</i> | UNITS/CYCLE(REF) | (LE | i) [(L | e) (f | (13) (13) (13) (13) (13) (13) (13) (13) | FT ³) |
| PICICRS | | | | | 705 .00 | 403 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | - | | | | | |
| | • | | Σ3 | <u> </u> | Σ③ .00 | 1408 |
| | | | Σ 3C | T/CYCLE . | IUIAL | 1408 VOL/CÝCLE FT³) |
| OTAL WT. | 04 | 101 | , (1 | • 1 | • | |
| MISSION CY | . 84 | 1 84 . Ys/m15510N | XO/ | CLE | .7/7 KG (LB) | (1.59) |
| OTAL VOL | | | (LB) | | | |
| MISSION " | 84 x DA | 184 YS/MISSION | _x0040 | ප_ • | .0183 | (.65) |
| LY | CLES/DAY DA | 12/WI22IOH | TOT. VOL/C (FT 3) | YCLE | M ³ (FT ³) | |
| | | | • | | • | |
| | <u> </u> | EXP | ENDABLES | REQUIREME | N T S | |
| • • | | Ď | ② | AMT. RECOVERED | | 4 |
| | AMT.USED/C | | RECOVERY | AMT.RECOVERED UXQ | | 51/ C YCLE - (3) |
| TYPE <i>PRETRUMFMI</i> | | B) | FACTOR | (LB) | | LB) |
| CHEMICAL | .5 | | N/A | N/A | | |
| | | | | | • | |
| | | • | • | | | |
| | | | | | | |
| | | | | | | |
| | Σ①5 | • | • | | Σω | |

| HABITABILITY SUBSYSTEM_ | 2.0 P | ersona | l Hygi | ene | | | - |
|--------------------------|---------|---------|--------------|--------|-------------|------|---|
| HABITABILITY FUNCTION | 2.2 B | ody Cle | <u>ansin</u> |] | | | - |
| APPLIANCE FUNCTION | 2.2.1 | Whole | Body | Shower | | | - |
| NUMBER OF CONCEPTS CONSI | IDERED_ | . 4 | | | • | | |

ASSUMPTIONS

- (1) Whole body shower concepts enclose the entire body to accomplish whole body cleansing. The showers are similar to terrestrial type; however, water usage is much lower.
- (2) The shower frequency used is one shower per man per day (Ref. 127 and 273). The use time for one shower is 15 minutes (Ref. 127).
- (3) Towels used for drying after showering, if required, are discarded after 60 drying cycles.
- (4) Washer/dryer penalty was based on washer Concept 7, Water Spray Agitation, and dryer Concept 1, Forced Hot Air-Electric Dryer.
- (5) Water used for Space Station Lody cleansing was assumed to be recycled minus the water loss associated with suspended solids. Shuttle water used is not recycled.

| | | | | , | | | | · · · · · · · · · · · · · · · · · · · | | | | |
|----------------|---------------------------|---------------|--|---------------|--------------------------------|-------------------------|---|---|---|----------------------------|---------------------------------------|--------------|
| CONCEPT USAGE | CONSUMABLES | AND FLOR | REGUI | REHENTS | THERMAL | REGATS | LEC | 2 TO TO TO TO TO TO TO TO TO TO TO TO TO | MT/VOL | 360345 | DEVEL MENT | A Taken Sala |
| USES/DAT | TYPE USED (*) *KG/USE- | : | TATE OF THE PERSON OF THE PERS | TEY C. | COCLANT -#ATTS+ (BTU/HR) | HT LEAK + 54 4 1 5 1 | A P B B B B B B B B B B B B B B B B B B | A 4 6 4 8 4 6 4 6 4 6 4 6 4 6 4 6 4 6 4 6 | # E | VOLUME 100 MI 100 MI | AVAIL INDEX | # 1 |
| 000.9 | 1 +0000 1 1 -0000 1 45.00 | : - | 00 | 21.1 | 317. | 292. | 250.0 16.0 | 1 6 0 2 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 179.5 | 2.34 | 1 1 | |
| | 5.000011 | (00. | (30.0) | 105.01 | : 594 | | 5370.0 | 0.41 | 177.6 | 2.02 | 0 | 252 |
| 052. | \$ 2.2680 \$ 2.2680 | 2680 (470-10) | 1551.4 | 40.4 | (15931.) | (271.) | 0.41 | \$370.0 | 1 392.01 | 1 71-16 | 1 | (4.4) |
| 6.009 .250 | 5 2.2680 | 000 | 1551.4 | 40.4 | 198. | 1574, | 536.0 | 00 | 224.0 | 3105 | 15 | (52.8) |
| 0.000 • 250 | \$ 2.7216 (6.0000)[| 000. | (25.0) | (1106.0) | (_2641) | 292. | 0.50 | 8 5 0 | 103.8 | 1.57 | S . | •••• |
| | | | | | * | • | _, | ` | | | · · · · · · · · · · · · · · · · · · · | |
| CONCEPT C | NCEPT | AHE | | | | | | | CIRCOLATED), LOST) | KG/HR KG/HR KG/HR | | : |
| YACU | VACUUM PICKUP AIR DRAG | | | OF . | | | | ATER | (CIRCULATED); (LOST) | KS/HR KG/HR | (LB/H3) (LB/H3) | |
| 1300 | RECMANICAL COLLAPSIBLE | | | GINAI POOR | | | 6 - MIPOSEN 7 - MITROSEN 8 - FREDA 9 - WATER | | (USED) (CIRCULATED), (PROCESSED), | KG/HR KG/HR KG/HR | (LB/HP) (LB/HR) (LB/HR) | |
| | | | | PAG | | | 3 ISA 17 AVA (++) | u a | | (***)COST | 80 . to | |
| | | | | E IS | • | | (1) AVAILABLE (2) STATE OF THE ART | AVAILABLE STATE OF THE ART | 018 | 0-25% 25-50% 50-75% | 34 M 34 | |

APPLIANCE - COLLAPSIBLE ** 40

£.

CONCEPT NUMBER

| | STEPPOINT TAFF | 10000 1 0 1 V 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | | | |
|-------------|------------------|---|------------|----------------|----------|---------------|--|---|---|------------|
| THERMAL PER | PENALTY - D | | OLANT FAK | (LB/BTUN) | | 1540 | A CONTRACTOR OF THE PARTY OF TH | | | |
| | - | | 5. | •7103 •5910 | | | | | | |
| | ٠, | | | | | | | | | |
| 35 | SELECTION MATRIX | • | (02/01/75) | • | WHOLE BO | DV SHOW | BODY SHOWER (SPACE STATION) | | | |
| ļ | | | | | | : | 2 | | | |
| FACTOR | VALUE | VALUE | PTS | | . 2 | m | | | | |
| | 228.74 | 504.85 | 151 | 3.24 | 3.35 | 00. | 8.20 | | | |
| NOTONE S | 55.297 | 107.74 | 0 | 2.34 | 3.40 | 00 | | | | I |
| 1 | 141.91 | 894.96 | 2 2 | 11.88 | 00. | 2.84 | 1.63 | | |)2 |
| | 86064 | 1.00000 | | 1.28 | 00. | 4.03 | . • | | | 1 |
| DEV COST 5 | 5.0000 | 000.00 | 1 5 0 8 | 5.63 | • 000 | 9.18 35.56 | 13-12 56-94 | | | 18 |
| | | | | 75.08 | , | 88.45 | | | | |
| | | | 1 | | | | - | | | 4 |
| ! | | | | | | | | | | ; |
| | | | | | | | | | | |
| | | | | | | | | - | | ; ; ; ; |
| | | | | | | | | | | : |
| | | | | | | | | | | |
| | | | | | | | | | ; | t |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 1 | | | | | | | | | ! | 1 |
| : | 1 | | | | | | | | | |
| : | | | | | | | | | | |
| | | | | | | | | | , | |
| | | | | | *** | | | | | |

| MOTHER 1 1 2 3 C 0 N C E P T | | SELECTION I | PARAME ON 100 | A T N N N N N N N N N N N N N N N N N N | |
|---|----------|-------------|------------------|---|-------|
| ## ## ## ## ## ## ## ## ## ## ## ## ## | ! !_ | | 1 | - d 3 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| ### ### ############################## | | *** | , ₁ 5 | 71.1 | |
| ## ## ## ## ## ## ## ## ## ## ## ## ## | | 1 | | 69.76 | |
| ## ## ## ## ## ## ## ## ## ## ## ## ## | | i | : n == | 1 | |
| SENSITIVITY ANALYSIS SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY -50 % SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY -50 % 1 2 3 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | | 9-19 | | 70.09 | |
| SINGLE SELECTION PARAMETER WEIGHTIG FACTOR BY #50 \$ 1 | | SERS | ITIVI | \$ | 2-113 |
| 1 2 3 4 C C O N C E P 40.56 8.44 44.45 71.18 52.45 7.00 49.05 72.88 44.85 9.31 39.73 68.36 44.85 9.31 42.73 68.36 51.31 6.74 47.41 72.68 46.50 9.31 42.72 72.44 50.34 8.71 42.70 72.34 50.81 9.31 42.58 69.49 | SINGLE | | PARC ON THE | INCREASING FACTOR BY #50 \$ | |
| 52.45 7.00 49.05 44.85 7.00 49.05 51.31 6.74 47.41 46.50 9.31 47.09 50.50 8.71 42.72 50.34 8.71 42.70 | - | 2 | i | T O Z O U | |
| 44.05 51.31 46.50 50.50 50.50 50.34 60.71 42.72 50.34 60.71 42.72 50.81 60.81 60.81 | <u>.</u> | 7.00 | | | |
| | | | 1 | 1 | |
| A THE CASE OF THE PARTY AND A STATE OF THE PARTY AS A | | | | | |

| | | ORI OF | SIR PO | VAI OR | D 62 | PA UA | G1 | e ; | N S | |
|---|-----------------------------------|-------------|-----------|-----------|---------|--------------|----------|----------|----------|--------|
| | | | | | | | | | | |
| | - N | | | | | | | | | |
| | WHOLE BODY SHOWER (SPACE STATION) | CEPI | | | | | | | | |
| | ER (SP | . 7 8 0 3 1 | 8.20 | 14.76 | 12.62 | 1.53 | 13.12 | 10.70 | 67.58 | 71.14 |
| 1 2 8 0 | DY SHO | | 00. | 13.61 | 2.84 | P . 4 | 90 | 00 | 35.55 | 37.43 |
| 04) • 05 | HOLE BO | 2 | 3.35 | 00.0 | 00 | 000 | 000 | 13.62 | 20.37 | 21.44 |
| (L8/810 (L8/810 (100) | • | - | 3.24 | 14.27 | 11.88 | . 97 | | | | 53,25 |
| EAK .7 | (02/01/75 | F15 | 15 | 51 | 15 | 5 0 1 | . 5 | <u>s</u> | 5 6 | 100 |
| DIRECT TO COOLAN CABIN HEAT LEAK WATT! TYPE ! | i | MAX | 504.85 | 107.74 | 894.96 | ***** | 40.000 | 52.842 | 45.000 | 100.00 |
| L PENALTY - STRECT TO COOLANT (LB/BTC) L PENALTY (LBS/WATT) TYPE 1 -7103 PENALTY (LBS/WATT) TYPE 2 - 5910 | SELECTION MATRIX | HIN | 228.74 | 60.350 | 14.14 | +87475 | 5.0000 | 4.8600 | . 00000 | 000000 |
| 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | | FACTOR | WE I GHT | POFER | THERMAL | RELIABOY | DEV COST | REC COST | TOTAL PT | 2 |

| | SINGLE | SINGLE SELECTION (BASED | OR EACH ON PARA ED ON 1 | CONCE HETER | EACH CONCEPT AFTER INCREASING PARAMETER WEIGHTING FACTOR BY 30.8 | | |
|--------------------|--------|-----------------------------------|-------------------------------|---------------------|--|--|--------------|
| | | , | , | . 0 | D R C E P T | |] |
| | - | ~ | n | * | | | |
| NORMAL | 53.25 | 21.44 | 37.43 | 71.11 | | | ! ! |
| #E1GHT | 1 | 21.51 | 34.69 | 69.93 | 76. | The second secon | |
| VOLUME | 51.76 | 22.07 | 32.56 | 70.01 | 11.1 | | |
| THERMAL | 51.55 | 19.87 | 36.07 | 72.09 | 60 | : | |
| MELIABOT | 52.39 | 20.69 | 38.98 | 70.10 | 23 | | |
| DEV COST | : | 19.87 | 4.2 | 72.33 | ,33 | | : |
| - CO3 | 7/11/6 | 76.07 | | : - - | -13 | | 1 |
|] • ; ; ; | | : : : : : | • • • • | : | | |) 2-{ |
| | | • | ENSTIT | ITY_A | SENS TIVITY ANALYSIS | | 18\$ |
| | SINGLE | RATING FOR SELECTION (BASED | | CONCE | EACH CONCEPT AFTER INCREASING PARAMETER MEIGHTING FACTOR BY -50 \$ | | [1-1 |
| | _ | | : - | , 2 0 * U | | | |
| NORMAL | 53.25 | 21.44 | 37.43 | 71.11 | | : | 1 |
| POPER | 1 | 21.36 | 40.63 | 72.55 | 55 8.0 | | |
| WOLUME THE BRAN | 54.92 | 20.75 | 39.51 | 72.38 | | | 1 |
| RELIAB-T | 24-17 | 22.02 | 35.79 | 72.23 | 23 | | • |
| DEV COST | 2000 | 23.28 | 35.28 | 69.73 | 1 And destrict the second state of the second sec | | |
| COST | 51.54 | 15.50 | • | 71.12 | 1.5 | | |

APPLIANCE CONCEPT COMPONENT SURMARY MATRIX

APPLIANCE FUNCTION: 2.2.1-WHOLE BODY SHOWER

OF SAFETY CRITICAL ITERS RECULATOR VALVE WELTEF VALVE ACCUMULATOR NALVE VALVE z SC..ENOID ш z 0 TEMPERATURE Δ Σ S CHECK 0 2 2 FILTER MATER Separator 0 CONTROLLER TIMER FXCHANGER w 8 Z \supset **dW**Nd REATER (C) ВГОМЕВ **AOTOM** COMPONENT TYPE APPLIANCE TYPE VACUUM PICKUP AIR DRAG MECHANICAL CCLLAPSIBLE

REF. NO. 127,278,273.236,209, & 129

| SPACECRAFT Space Station | |
|---|--------------------------------------|
| HABITABILITY SUBSYSTEM Personal Hygiene | HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION Whole Body Shower | |
| APPLIANCE CONCEPT NO./TITLE 1/Vacuum P | ickup |

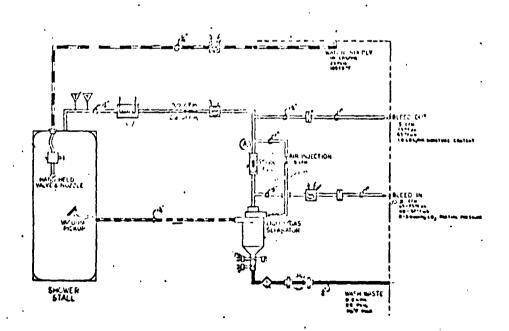
 $\not E$

DESCRIPTION

INDEX NO.

2.2.1.1

The vacuum pickup concept is a shower stall, which includes a transparent door, and is sufficient in size to allow adequate movement of the crewman during showering and stall cleanup. Water is retrieved by a vacuum pickup system and pumped to the water waste management system. The pickup system allows the crewman to collect water from free air and the stall wall, floor, and door. The shower includes a water distribution system which insures proper cleaning with minimum water usage. A fan is used to circulate air to the shower with a cabin air bleed for carbon dioxide control within the stall. The circulated air is heated to provide a comfortable shower environment. The crewman uses terry towels for drying after showering. The terry towels used for the study are 16 x 24 inches and are assumed to contain one pint of water after drying (278). This concept has been brought to the prototype stage and is scheduled to be tested at MASA JSC.



D2 1180017 APPELANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT INCOME. PICKUP

INDEX NUMBER 2.2.1.1

| ELECIRI | CAL | POWFR | REQUIREMENTS |
|---------|-----|-------|--------------|
|---------|-----|-------|--------------|

| | 65 | A | C . POWE | | | C POWE | |
|--------------------------|-----------|-----------|----------------|----------------------------|-------------|------------------------|----------------------------|
| | DSE 114E | ② PEAK | (3) Average | (4) DEMAND (WATT-HP/ | ⑤ PEAK | (6) AVERAGE | (/) DEMAND (WATT-PR/ |
| COMPONENT (REF | (HR) | (WATTS) | (WATTS) | () × () | (ATTS) | (WATTS) | Ox (1) |
| BLOWLR (AIR) (12) | | _88_ | _88_ | 22_ | - | | |
| HIR HELLIGIE | | 104 | 104 | 26 | | | , |
| WAILE POMP SOUNOMENES | MINI MARY | _57.5 | 57.5 | <u>_14:1</u> _ | 16 | 16 | |
| DELLINE IN L. IVI. S.E. | | | | | | | |
| | | | ~~~ | | | | |
| | | | | | | | |
| | | | | • | | | • |
| | | 249.5 | • | 62.4 | 16 | • | |
| | | MAXIMUM . | | TOTAL | MUMIXAM | | TOTAL |

THERMAL. REQUIREMENTS

| | SOURCE | LATENT (BTU/HR) | SEMLIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
|-------|-----------------------------------|---------------------------|---------------------------|-----------------------------|-------------------------------|
| SUSWE | L BLELD TOLNBIN L DOOK TOLABIN | | | 372 | _8zo |
| | GLWAN | 264 | - | | 264 |
| ` | TOTAL | 336.2(1084) WATT (BTU/HR) | 109.1°(372) MATT (BTU/HR) | 109,1(372) NATT (BTU/HR) | 336-2 (1084) MATT (BTU/HR) |

OPERATIONAL

| • | | ERMAL" | ELECTRICAL | WE 1GHT | VOLUME |
|--------|-------------------------------|--|------------------|----------------------------|---|
| SOURCE | HEAT LEAK (BTU/HR/CYCLE) | TO COOLANT (BTU/HR/CYCLE) | (PK WATTS/CYCLE) | (LB/MISSION) | (FT ³ /MISSION) |
| WASHLE | 930 | | 44 | 37.1 | 3.32 |
| DRYCK | 67.5 | 125_ | _55.4 | 19.8 | 3.26 |
| | | ······································ | | | |
| | | | · | | |
| TOTA | | 36.7 (125) | 99.4 | 23.5 | .186 |
| | WATTS/CYCLE (BTU/HR/CYCLE) | WÄTTS/CYCLE (BTU/HR/CYCLE) | | KG/H15510N (LB/M15510N) | M ³ /M155104 (FT ³ /M1551CM) |

D2-1135617/

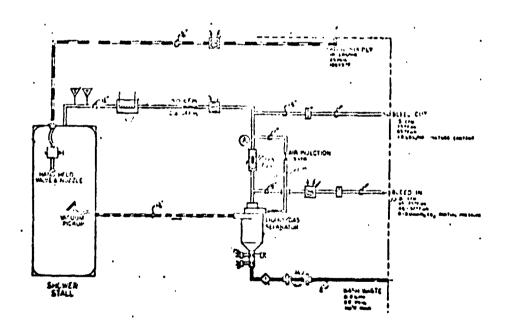
APPLIANCE CONCEPT REQUIREMENTS AND TERMETTES CALCULATIONS (CONCLOSED)

| | ELXED | EIGHIM | rotume <u>re</u> | Q U.I R F M F M T S | |
|---|---------------------------------------|--|--|---|---------------------------------|
| COMPONENT | (REF) | | WEIGHT (LDS) | | VOLUME (FT+) |
| <u>SIKUULE, SINU</u> Componentiisu | (127) | | 148 173 | ······} | 71.L |
| TOWELS | | | 5.96 | | 4.6 |
| | | | | | |
| | | | | • | |
| | | | | | |
| | | | | | |
| - | | | | | |
| | TOTAL | | 148.3 (3. | 26.9) | 2.14 (75.7) |
| • | SOLID EXP | ENDA3L | E WT/YOL | REQUIREMENT | , |
| | _ | WT/UNIT (R | <u> </u> | (1) | ® |
| TYPE | <pre>UNITS/CYCLE(REF)</pre> | (PKG.WT/UNIT |)(REF) ① X (2 |) (PKG.VOL/UNI) | ()(PEI) ()x(4) (+1') |
| TOWELS | _0166 (2:4) | | | • | |
| | | | (236) | <u>ن که .</u> . | (39 2) |
| | | | | | |
| The Apparatual Co. of The Environment Sprangers and | | | organisation is a season of the season of th | | |
| | | A SEAL OF THE PARTY OF THE SEAL OF THE SEA | | | Anguarana |
| | | | Σ3 .005 | g Graf | Σ (5) 00417 101AL VILL/CYCLE |
| τοτλι ντ. | | 1001 | · (LB) | , | (ロリ |
| WISSION CYCLE | S/DAY DAY | 184 S/MISTON - 1 | - x 005 9 101.417,71 | <u> </u> | 2.7 (LB) (5.96) |
| TOTAL VIL | | | (LB) | | |
| "Mission (| S/DAY DAY | 84. 5, 455108 | x004/7 101.VOL/C1C (HT*) | | .13 _{H' (+1')} (4.6) |
| | <u>6 A S/L 1 Q U 1 D</u> | EXPE | NDABLES R | EQUIREMENTS | . |
| · | Q | | 0 | AHT, RECOVERED/CYCE | E AMT LOST/CYCLE |
| TYPE | AMT. USED/CY | CLE (REF) | - RECOVERY FACTOR | () 1(2) | O - (3) |
| WATER | (LB 5.0 | (273) | 10009 | 4.4955 | .0045 |
| WASHLE WALLE | · · · · · · · · · · · · · · · · · · · | | 1 -0.00 | 3 20/0 | |
| LOSS PINALI 1. | | | _1-,0009_ | 3.3969 | .0031 |
| | | | | | |
| | Σ0 8.4 | | | ۲. | · .0076 |
|) | | | | 2.4 | 197 al/lul/lo |

| • |
|--------------------------------------|
| MABITABILITY FUNCTION Body Cleansing |
| |
| 1 |
| REF. NO. 278, 127 |
| |

DESCRIPTION

The air drag concept is the same as Concept 1 with the exception of body drying. Body drying is accomplished by heated air passing over the crewman's body while in the stall. The concept eliminates the requirement for towels and the associated washer/dryer penalties; however, it is a high power consumption unit.



| | \$OURCE | HEAT LEAK (BTU/HR/CYCLE) | 10 COOLANT (BTU/HR/CYCLE) | ELECTRICAL (PK_WATTS/CYCLE) | WCIGHT (LB/MISSION) | "VOLUME (FT" /MISSION) |
|---|---------------------------------------|-------------------------------|-------------------------------|-----------------------------|----------------------------|---|
| - | N/A | . • | | | | |
| | · · · · · · · · · · · · · · · · · · · | | | | | |
| | | | - | | | |
| | · | | | | | |
| t | | ·, | • | | | |
| | TOTAL | NATIS/CYCLE (BID/HR/CYCLE) | WATTS/CYCLE (BTU/HR/CYCLE) | | KG/MISSION (LB/MISSION) | M ³ /RISSICN (FT ³ /MISSICS) |

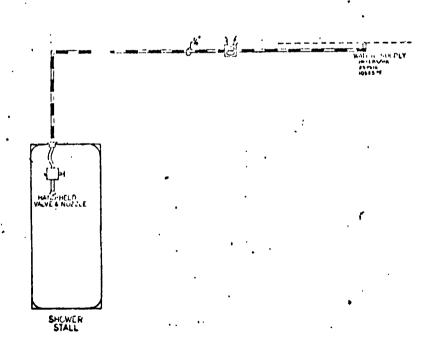
D2-WC567-7 APPLIANCE CONCEPT REQUIREMENTS AND PERMITTES CALCULATIONS (CONCERDED) INDEX NUMBER 2.2.1.2

| | EDVL ETEŠY (127) | | 148 234 | } | 71.1 |
|-----------------------------|---|---|-------------------------|---|---|
| | TOTAL | | 173.3 (382) KG (LBS) | | 2.01 (71.1) M³ (FT³) |
| TYPE N/A | SOLID EXP UNITS/CYCLE(REF) | ENDABLE WT/UNIT (REF) (PKG.WT/UNIT)(RE (LB). | WT. CYCLE | U 1 R E M E N T S VOL/UNIT (REF) (PKG. VOL/UNIT)(FI (FT3) | VOL/CYCLE (FT ³) |
| 0 , WT. = M15510V = CYCL | FS/DAY DA | YS/MTSS10N X | TOTAL MT/CYCLE (LB) | Σ | TOTAL VOLVEYCLE (FT3) |
| OTAL VOL = CYCL | <u>G A S/L 1 Q U 1 D</u> (AMT.USED/C | D YCLE(REF) | @ · | IREMENIS T.RECOVERED/CYCLE OXO OXO | M ³ (f1 ⁴) AMT LOST/CYCLE (1-3) (LE) |
| WATCK | | | 7-,009 | 4.9955 ΣΦ | .0045 |

| SPACEC RAFT | Space Stat | ion | · | - | | |
|--------------------|---------------|----------|-----------|--------------|--------------|----------------|
| HABITABILI | ITY SUBSYSTEM | Personal | Hygiene | HABITABILITY | FUNCTION_ | Body Cleansing |
| APPLIANCE | FUNCTION | Whole B | ody Showc | r | | |
| APPLIANCE | CONCEPT NO./1 | ITLE | 3/Mechani | ical | | |
| INDEX NO | 2.2.1.3 | | · | REF. NO. | 278 | |

DESCRIPTION

The mechanical shower concept is whole body showering without air recirculation and vacuum water retrieval systems. The water is picked up manually using towels. The towels are washed and dried after use. Five towels per shower (Ref. 278) are required for crewman drying and water pickup. Each towel is assumed to hold 1.0 pints of water. The stall and water distribution system are identical to Concepts 1 and 2. Water recovery from the towels is accomplished by spin drying in the washing machine. The amount of water left in the towel after spin drying is neglected since it is equivalent to towels being washed and then dried. This is a valid assumption because the towels are washed after each shower.



APPLIANCE CONCEPT REQUIREMENTS AND PLNALTITS CALCULATIONS CONCEPT 3/1115 CALCULATIONS INDEX NUMBER 2,2.1.3

| <u>E L Ē</u> | CTRICAL | POWER | REQUIREMENTS |
|--------------|---------|-------|--------------|
|--------------|---------|-------|--------------|

| | | • | AC. POWER | | | DC POWER | | |
|-----------|-------|---------------------------|----------------|-------------------|-----------------------------------|----------------------|---|-----------------------------------|
| COMPONENT | (REF) | USE TIME CYCLE (HR) | ② PEAK (WATTS) | ③ AVEPAGE (WATTS) | (4) DEMAND (WATT-HR/ CYCLE) ① × ③ | ⑤ PEAK (WATTS) | ⑥ AVEPAGE (WATTS) | (/) DEMAND (WATT-HR/ CYCLE) ① X ② |
| -N/A - | | | | | | | | |
| | | | | | | | | , |
| | | | | | | | *************************************** | |
| | | | | | | | • | • |
| | | | MAXIMUM . | | TOTAL | MAXIMUM | | TOTAL |

| | SOURCE | LATENT (BTU/HR) | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HK) | TO COOLANT (BTU/HR) |
|---|-------------------------------------|-----------------------------|----------------------------|----------------------------|-----------------------------|
| | UR DODR TO CARIN URE CARFILD OUT | <u></u> | 372_ | 372 | |
| | COMPRESS . | 269 | | , | 260 |
| | | | | | |
| • | TOTAL | 77.4 (264) WATT (BTU/HR) | (09 (372) WATT (BTU/HR) | 109 (372) WATT (BTU/HR) | 77.4 (264) WATT (BTU/HR) |

OPERATIONAL PENALTIES

| • | | RMAL' | ELECTRICAL | WE 1GHT | VOLUME | |
|--------|-------------------------------|-------------------------------|------------------|----------------------------|----------------------------|--|
| SOURCE | HEAT LEAK (BTU/HR/CYCLE) | TO COOLANT (BTU/HR/CYCLE) | (PK WATTS/CYCLE) | (LB/MISSION) | (FT3/MISSION) | |
| WASHER | _50Zo_ | - | 237 | 200 | 17.9 | |
| DEYCE | 363_ | 675 | 299 | 80 | 17.6 | |
| | | | | | | |
| | | | | | | |
| 701/ | 1578 al (5383) | 198 (675) | #2% | /27 _(280) | 1.0 (35.5) | |
| . 1017 | NATTS/CYCLE (BTU/HR/CYCLE) | KATTS/CYCLE (BTU/HR/CYCLE) | | KG/MISSION (LB/MISSION) | M3/H1221GA (NOTSZIW/LL) | |

10

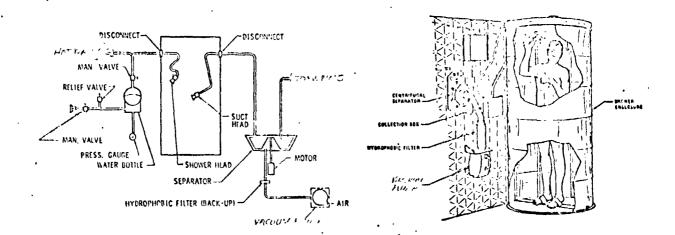
| F | 1 | X | E | D | W | ŧ | ľ | G | Ĥ | ۲ | <i></i> | 0 | t | ţţ | М | £ | R | F | n | ij | ī | R | F | M | E | N | Т | S |
|---|-----|---|-----|---|---|---|-----|-----|---|-----|---------|-----|---|----|---|---|---|---|-----|----|---|---|---|---|---|---|----|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| _ | • • | | • • | | - | | • • | ~ ~ | - | . ~ | - | . ~ | | _ | | - | | | - 1 | * | ~ | | - | | | | •- | - |

| COMPONENT SHOW: 1 ST. TOWE 65 (ET. | | | WEIGHT (LES) 148 29.6 | | VOLUME (153) 49 22.9 |
|--------------------------------------|----------|----------------------|---|--|--|
| | | TOTAL | 80.6 (17 KG (LBS) | 7.6) | 2.03 (71.9) M3 (FT3) |
| TYPE TOWCLS | UNITS/CY | D WT/UNI (PKG.WT/ | ⑦ ③ I (ref) WT/CYC! UNIT)(REF) ① X ② LB) (LB) | (PKG.VOL/UNIT)(Ř (FT³) | (F13) 3) ,0208 |
| OTAL VOL | | | ∑3 _,026 TOTAL NT/((LB) X _,026 (LB) x _,0208 N TOT.VOL/CYCL | | (5) ,020 g TOTAL VOL/CYCLE (FT3) 3.4 (29.6) KG (LB) (29.6) |
| TYPE WATUS WASIIGE W | <u> </u> | | (FI3) PENDABLES R | EQUIREMENTS AMT.RECOVEHED/CYCLE () X () (LB) - 4.9955 | ##T LOST/CYCLE ①-③ (LB) |
| LOSS PUNAL | | 18.5 | 10009 | ΣΘ | .0166 |

| SPACECRAFT Space Stat | ion |
|-------------------------|---|
| HABITABILITY SUBSYSTEM_ | Personal Hydiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION W | hole Body Shower |
| APPLIANCE CONCEPT NO./T | ITLE 4/Collapsible (Skylab) |
| INDEX NO. 2.2.1.4 | REF. NO. 279,283,297,282,255,209 |
| | |

DESCRIPTION

The collapsible shower concept was used on Skylab. The shower stall is folded down for use to minimize space. The shower enclosure consists of two end ring closures and a translucent Beta cloth skirt with stiffening rings. One end ring attaches to the floor and the other to the ceiling when the shower is in use. Water is delivered through a nozzle with vacuum pickup of water. The waste water is centrifugally separated and routed to the water waste management system. Six pounds of water were used for this concept per shower (Ref. 282). One towel per crewman per shower is used for drying.



おっ

| CONCEPT 4/COLLAPSIA | APPLIA GC (SA | NG CONCEPT F (44.08) | EQUIPENENTS AMO | PENALTIES CAL | COE ATTONS INDEX | NUMBER 2.2 | °-1.4 |
|---|-------------------|--|---------------------|-------------------------------|-----------------------|-----------------------|--------------------------------------|
| | E L'E C | TPICAL | <u>P O W E</u> R | REQUIR | LMENTS | | |
| | _ | | AC POW | F R | D (| C POWE | R |
| | USF TIPE CYCLE | (2) PEAK | (3) AVL!'AGE | DEPARD (WATT-RP/ CYCLE) | (5) PŁAK | (E) | (7) DEMAND (WATT-HH) CYCLE) |
| COMPONENT (REF) | (HR) | (WATTS) | (WATIS) | (D) x (3) | (WATTS) | (WATTS) | () x () |
| WATER SUMMANUESS | | | | 7.0 14.4 | 1 | | |
| | | | | | | | • |
| | | | | | | | |
| Married type waster or an extensive design and the second | | | | | - | | |
| | | | - | | | | |
| | | | | · · | | | |
| | | • | • | | | • | |
| | | 85.5 MAXIHUM | ٠ | 21.4 TOTAL | MAXIMUM | • | . TOTAL |
| , | | | | | | | , |
| | • | | | | | ė | |
| | | | • | • | · | | |
| | | I H E R M A I | E REQUI | REMENIS | | • | |
| • | | LATENT | çr | NS1BLE | HEAT LEAK | 70 | COOLANT |
| SOURCE | | (BTU/HR) | | TU/HR) | (BTU/HR) | | STU/HP) |
| SHOWER INCLOSURE | TIMA | <i>III</i> – | | 364 | _864 | | |
| | | | | 36 T | <u> </u> | | |
| MOISTURE CAPPIEL | 2001 | | | | | | |
| BY CREWIMAN | | 264 | | | | | 264 |
| | | | | | | | |
| | | | | | | | |
| 1 | ~ | | | | | | |
| | TOTAL | 77.4 (26 | 4) 25% | 9(969) | 253.4(36 | <i>1)</i> 77 | 4 (264 |
| | | WATT (BTU/HR | t) WATT | (BTU/HR) | WATT (BTU/HR) | • | (BTU/HP) |
| | | • | | | • | | |
| ` | | | | | | | |
| | | | | | | | |
| , , | • | | | | | | |
| • | | | | | | | |
| | ! | <u>OPERATI</u> | ONAL PI | ENALIJES | <u>S</u> | | |
| | | Tuchu. | , | | | • | |
| 1 | | THERM/ T LEAK | TO COOLANT | ELECTRICAL | | | OLUME |
| SOURCE . | (BTU/HR | /CYCLE) (| (BTU/HR/CYCLE) | (PK WATTS/CY | CLE) (LB/MISSI | ION) (FT ³ | (NISSION) |
| WASHER | 9 | 30 | | _44_ | | <u></u> | 3.32 |
| DRYER | | <u>67,3 · </u> | 125 | 55.4 | 14.8 | 3 3 | .26 |
| | | | | | | | |
| • | | | | | ···· | | - |
| } | | | | | | | |
| | | | | | | | |
| • | | 2.5 | 36.7 | An A | 23.5 | 5 | .186 |
| 10 | | 77,3) | (25) WATTS/CYCLE | _97.4_ | | / | ,53) |
| | ., (Biu) | MR/CYCLE) | (BIU/HR/CICLE) | • | KG/MISSI (LB/MISSI | ON) (FT) | AK12210A) AK12210A |
| | • | | | | | • | |

1/2

| | CONCENTA/COLLAPSIE | APPLIANCE CONCEPT I | EE QUIREMENTS AND | PENALTIES CALC | UEATION / (LOTE) ONED) INDEX 10 | IMPER 2.2.1.4 |
|--|--------------------|---------------------|---|----------------|---|--|
| TOTAL TI.GS (157.74) 1.38 (45.7) | | <u>FIXED</u> WE | 1 <u>6</u> H T/V 0 L U | | U.I P F M F N I S | VOLUME |
| TOTAL 71.65 (157.76) 1.38 (45.7) REQUIREMENT 15 SOLID ELPENDABLE MITTOLE REQUIREMENTS WIGHT (REF) MICROLE (REF) MICROLE (REF) MICROLE (REF) (REF) MICROLE (REF) (REF) (REF) (REF) TOPP WHITS CRELL (REF) | | | | | | (FŢ¹) |
| TOTAL 71.65 (157.76) 1.38 (45.71) KG (LES) KG (LES) KG (LES) KG (LES) KG (LES) KG (LES) KG (LES) KG (LES) KG (LES) KG (LE | | NAZILI (MEFC) | | 152 5.96 | | 4.6 |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | | | | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | • | | | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | | • | | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | Substitution and the species are | | | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | | | , | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | | | | • | |
| SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOL REQUIREMENTS SOLID EXPENDABLE MIVOLE (PRO, WILDER) WILCOLE (PRO, WILCOLE) WIL | | TOTAL | 71 | .65 (157 | 7.96) | 1.38 (48.4) |
| Topic Type | | | • • | | | and the second s |
| Topic Type | 6.0.1 | | | U T () () | | , |
| TYPE UNITS/EYELL (REF) (PKG, WI/CMIT), F) (RE) (PKG, VOI //MIT) (REF) (RES) TOWN INT. DIAM WIT. PHISSIDY X DAYS/HISSIDY X DAYS/HISSIDY X DAYS/HISSIDY (REF) MISSIDW X JS 4 X COS 4 Z.7 (REF) EVELTS/DAY X DAYS/HISSIDW X DAYS/HISSIDW (REF) TYPE WATLUSTD/CYCLE (REF) (RECOVERY (REF) (REF) (REF) WATLUST (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF) (REF) (REF) (REF) (REF) (REF) (REF) WATLUST (REF) (REF | 3 0 1 | | 0 | (3) | _ | (9) |
| TOTAL WIT. SASYLIGHT BATTER ANT. BESSION ANT. BECOVERY FACTOR (18) ANT. BESSION ANT. BECOVERY MILESTON (18) ANT. BESSION ANT. BECOVERY MILESTON (18) ANT. BESSION ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BECOVERY MILESTON (18) ANT. BESSION (18) | TUDE MILT | (P) | (G.WT/UNIT), 「) | | VOL/UNIT (REF) (PKG.VOL/UNIT)(F | VOL/CYCLE (EF) (1) X (4) |
| DOTAL WILL TOT | | | | (18) | .125120 | 0) .00417 |
| TOTAL WT. MISSION CYCLES/DAY X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION DAYS/MISSION TOTAL WT. RECOVERY FACTOR (LB) FACTOR CLB) COS 9 DAYS/MISSION TOTAL WT. MISSION DOWN CYCLED/DAY DAYS/MISSION DAYS/MISSION DOWN AMT. RECOVERY DAYS/MISSION TOTAL WT. MISSION CYCLED/DAY DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DOWN DAYS/MISSION TOTAL WT. MISSION DOWN DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISSION TOTAL WT. MISSION TOTAL WT. MISSION DAYS/MISSION TOTAL WT. MISS | | | .322 / | | 250.720 | 7 |
| TOTAL WT. MISSION CYCLES/DAY X DAYS/MISSION TOTAL WOLL CYCLES/DAY X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION | | | - | | | |
| TOTAL WT. MISSION CYCLES/DAY X DAYS/MISSION TOTAL WOLL CYCLES/DAY X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION | | | | | | |
| TOTAL WT. MISSION CYCLES/DAY X DAYS/MISSION TOTAL WOLL CYCLES/DAY X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION | | | | | | |
| TOTAL WT. MISSION CYCLES/DAY X DAYS/MISSION TOTAL WOLL CYCLES/DAY X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION CYCLES/DAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION TOTAL WIT. MISSION CYCLEDAY X DAYS/MISSION TOTAL WIT. MISSION | | | 56 | | 2 : 5 | |
| TOTAL WT. MISSION CYCLES/DAY MISSION CYCLES/DAY MAT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) COMPANIES OF THE CONTROL (LB) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. USED/CYCLE (REF) AMT. RECOVERY (LB) | | | 20 | TOTAL WITCY | CLE . | TOTAL VOLVEYOUE |
| TOTAL NOT | TOTAL MT. | v 18 | d v | mea | • [| ا درد رسوره سنست سویده، |
| TOTAL NT. SA S/L I Q U I D | CYCLES/DAY | V DAYS/ | ทรราชส ^ | | l | |
| CYCLLS/DAY DAYS/MISSION TOTAL NT. CYCLL/DAY TOTAL NT. CYCLL/DAY TOTAL NT. CYCLL/DAY TOTAL NT. CYCLL/DAY TOTAL NT. CYCLL/DAY TO | TOTAL VOL = | , 100 | 1 , | · · · _ | . | 73 7a () |
| GAS/LIQUID EXPENDABLES REQUIREMENTS TYPE MAT.USED/CYCLE(REF) FACTOR (LB) FACTOR (LB) FACTOR (LB) FACTOR (LB) COSS | CYCLES/DA | Y A DAYS/F | เรรางกั | TOT VOL /CYCLE | L | M1 (F17) (77.65) |
| TYPE AMT. USED/CYCLE (REF) (LB) FACTOR (LB) FACTOR (LB) FACTOR (LB) (| | | | (11-) | | • |
| TYPE AMT. USED/CYCLE (REF) RECOVERY DX (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) | G / | A S/L I Q U I D | EXPENDA | BLES RE | QUIREMENTS | |
| TYPE (LB) FACTOR (DX (DX (DX (DX (DX (DX (DX (DX (DX (DX | | | stand the many or many space through | | _ | ① |
| WASLIER WATER LOSS PENALTY 3.4 10009 3.3949 .0031 \[\Sigma \] \[\Sigma | | AMT. USED/CYCLE | (REF) | | (1) x (2) | (1) - (3) |
| WASHER WATER LOSS PENALTY 3.4 10009 3.3969 .0031 \[\sum_{\text{TOTAL NT.}} \sum_{\text{CYCLL/DAY}} \sum_{\text{DAYSHISSION}} \sum_{DAYSHIS | | | (282) /- | | 5.9946 | |
| Σ① 9.4 Σ① .0085 TOTAL NT (2001/20AY × 184 × 0085 · 9.35 · 9.4 · 8.52 (18.8) KG (18.8) | WASILER WATER | | · · | | 2010 | |
| TOTAL NT | LOSS PUNALTY | 3.4 | | .0007 | 3.3967 | 0031 |
| TOTAL NT | | | | | | |
| TOTAL NT | | ~ ~ ~ ~ | - Andrews - Andrews - Andrews - Andrews | | | |
| HISSICH CYCLE/DAY DAYS/HISSION TOTAL LOCACE 7.35 • 9.4 [8.52 (0.6)] | Σ | U7.4 | | • | 20 | 0085 |
| CYCLL/DAY DAYS/MISSION TOTAL TOTAL COLLECTE KG (LB) | TOTAL NT. | , IPA | · | c 9 | 28 . 91 . | 8.52 (IRA) |
| | CYCLE/DAY | - ^ - DAYS/HISSION | î Tor ăl ruli | rerett. | | KG (LB) |

| MABITABILITY SUBSYSTEM 2.0 Per | sonal Hydiene . |
|--------------------------------|-------------------|
| HABITABILITY FUNCTION 2.2 Boo | y Cleansing |
| APPLIANCE FUNCTION 2.2.2 Par | tial Body Washing |
| NUMBER OF CONCEPTS CONSIDERED_ | 6 |

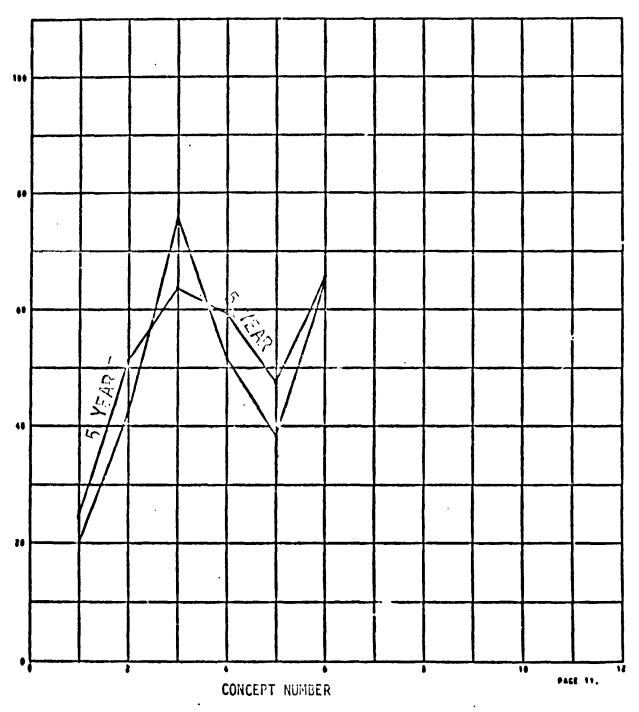
ASSUMPTIONS

- (1) The partial body washing is the washing of local body areas (i.e., feet, hands, face).
- (2) Washer/dryer penalty was based on washer Concept 7, Water Spray Agitation, and dryer Concept 1, Forced Hot Air-Electric Dryer.
- (3) Water used for Space Station body cleansing was assumed to be recycled minus the water associated with the suspended solids. Shuttle water used is not recycled.
- (4) Partial body washing frequency used for the study is 10 times per day per man with a use time of the wetting unit or equivalent of 2.25 minutes per use.
- (5) Washcloths or reusable paper wipes, if required, are discarded after 60 washing cycles.

| | NO. 2.2.2 | • | PARTIAL | ₩004 | 9721574 | ING (SPACE ST | STATION | â | | | | 1 | ALIEN . | F | 7. | |
|-----------|---|----------------|---|---|---------------------------------------|---------------------------------------|---|---|-------------------|----------------|---|---|--|----------------------------|-------------|---|
| | USAGE | CONSI | CONSUMABLES_A | AND FLOR | ₩. | STUB REMENTS | i | THERMEL | REBRIS | - ELEC PR | STEGETS. | #T/VOL | PEGMTS | BEVELC" | ا ج ا | SUPPLY |
| | USES/DAY TYPE USES/USES/USES/USES/USES/USES/USES/USE | | • | FL0# | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0 | 10010 10010 10010 10010 10010 | MT LEAK HATTS+ | PK PRR | | # H H H H H H H H H H H H H H H H H H H | ************************************** | A V A | . H | |
| | .037 | 7 8 | .000711 .2268 | 600 | 0. (0.) (0.0E) | 1 70.01 | - | 360.1 | 278. | 0. | 0.040 | 1000 M | 5.72 | ~ | 30 | 2 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 |
| | 60.000 | • | .3403 | .02) | 1551.4 | 0.0 | 1 | 360.) | 278. | 0.005 | 360.0 | 21.4 | 1 | | 30 | |
| ' | .037 .000.04 .037 | • | .0227 | 600 | 1551 | | - ~ | 0.3 433. 2160.1 | 111. | 52.8 | 2 0. 20. | 1274.0) | 1 24.80 1 1.70 | ~ | 8.0 | (1270-0) |
| | -0000-0 | • | 2.710011 | 000 | (30.0) | 00 | <u> </u> - | 105. | 311: | 500.0 | 3.000 | 57.9 | 1 20+59 | 2[| 30 | 19.2 |
| | 000.00 | - | .525011 | 000 | 1910.0 | 1125.01 | - | 110.1 | 100.1 | 140.0 | ••• | 433.12 | 3.45 | - | • | 177.0 |
| PPL! ANCE | : | | : 4' 2, | = | i 1 | E | CABIN | A 8. | (CIRCULATED) | ED), LITERS/SE | C (F13 | ল ম | | | · i | ť |
| | DISSERVED DESCRIPTION OF STREET DESCRIPTION | ا با کار آھي ا | MET MIPES T BIPES PONGE SMCLOTHES WASHCLOTHES | PES SS (PREPACKAGED) HES (SKYLAB) | [60] | | CAZIN AIR CONCING WA NATER NITROSEN FREON | CASIN AIR OXYGEN COOLING NATER WATER NITHOSEN NITHOSEN NITHOSEN | | | (LE/RB) (LE/RB) (LE/RB) (LE/RB) (LE/RB) | | (**) <u>AVAILABLE</u> (1) AVAILACLE (2) STATE OF THE ART (3) SCHE DEVELOPMENT REQUIRED | SLE IZ ART IPMENT RI | EQUIRED | 0-25¢ 0-25¢ 25-50¢ 50-75¢ |

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - DISPOSABLE ACT VIPES
2 - REUSABLE ACT VIPES
3 - DISPOSABLE VIPES (PREPACKAGED)
4 - AUTOMATIC SPONGE
5 - REUSABLE WASHCLOTHES
6 - DISPOSABLE WASHCLOTHES



Partial Body Washi | (Space Station) Concept Trade

| # D C C C C C C C C C C C C C C C C C C | 15 (-0.2/01/75) (02/01/75) (15 (-0.3) | UE FTS 1 2 3 C O N C E F T UE FTS 1 3 C O N C E F T UE FTS 1 3 C O N | 102/01/751 | (02/01/75) (02/01/75) (02/01/75) (02/01/75) (03/01/75) (04/05) (05/01/75 | | | | | <u> </u> | | į | | |
|---|---|--|--|--|-----------|-------------|---------------|------------|----------|------------------|----------|------|-------|
| 124.0 15 6.36 14.45 . 0 0 0 0 0 0 0 0 0 | 1274.0 Fis 2 3 4 5 5 5 5 5 5 5 5 5 | 1244C | 1294.0 F15 | VALUE FTS | E STATION | (S P A C E | 0 × 1 × 0 × 0 | | ا د | • ; | 2//10/ | (05, | |
| 15 4-36 | 15 | 15 | 15 6.36 14.45 .00 14.74 13.52 9.98 | 15 | , | | 0 | | | <u> </u> | 1 : | • | |
| 1294.0 15 6.36 14.45 .00 14.74 13.52 9.98 355.00 15 .00 9.74 202.12 10 .00 9.74 155.31 15 141 141 15.00 3.29 100.00 15 .00 12.00 .00 13.50 80.000 80 15.99 33.62 5.00 12.00 6.00 13.50 100.00 100 19.98 42.27 75.66 51.70 38.41 64.96 | 1294.0 15 6.36 14.45 .00 14.74 13.52 9.98 255.00 15 .00 .00 15.00 13.42 202.12 10 .00 9.74 155.31 15 1.41 15.00 3.29 .00 13.18 1 100.00 15 6.00 6.00 12.00 .00 13.50 100.00 100 19.98 42.27 75.66 51.70 38.41 64.96 | 1294.0 15 6.36 14.45 .00 14.74 13.52 9.98 .202 23.57 23.42 .90 9.74 .202.12 13 .00 .00 13.42 .90 | 1294.0 15 6.36 14.45 .00 14.74 13.52 9.78 255.07 15 .00 9.74 .00 9.74 255.07 15 .00 9.74 8.53 9.79 155.34 15 141 15.00 3.29 .00 13.15 150.00 5 156 156 5.00 .00 .46 .45 150.00 15 156 156 5.00 .00 .46 .45 150.00 15 15 15 15 15 .00 .46 .45 150.00 15 15 15 15 .00 .46 .45 15 15 15 15 .00 .00 13.50 15 15 15 15 .00 .00 13.50 15 15 15 15 .00 .00 .00 .00 15 15 15 15 .00 .00 .00 .00 15 15 15 .00 .00 .00 .00 .00 15 15 15 .00 .00 .00 .00 15 15 15 .00 .00 15 15 15 .00 .00 15 15 15 .00 .00 15 15 15 .00 .00 15 15 15 15 .00 15 15 15 15 .00 15 15 15 15 .00 15 15 15 15 .00 15 15 15 15 .00 15 15 15 15 15 .00 15 15 15 15 15 . | 15 | • | uh | • | , n | ~ | - | 218 | | AALU |
| 205.00 15 | 205-10 | 205-102 15 - 00 15-00 13-42 15-00 13-42 15-00 15 | 155.34 15 .00 .00 15.07 13.42 .00 9.74 222.12 10 .00 9.74 9.52 9.9 3.97 155.34 15 1.41 15.00 3.29 .00 13.15 1.0000 5 1.54 9.55 0.0 13.15 1.0000 15 4.00 6.00 12.00 .00 6.00 13.50 100.00 100 19.98 42.27 75.44 51.70 38.41 44.94 | 15 | 2 9.98 | = | 14.74 | 00. | 14.45 | . 96.9 | 151 | | 1294. |
| 1.0000 | 155.34 15 1141 15.00 3.29 .00 13.18 1.0000 5 .66 .66 5.00 .00 .00 .13.18 1.0000 15 6.00 12.00 .00 6.00 13.50 80.000 80 15.89 33.82 60.53 41.36 30.73 51.97 100.00 100 19.98 42.27 75.66 51.70 38.41 64.94 | 155.37 15 1.41 19.00 3.29 .00 13.16 1.0000 5 .04 .04 5.00 .00 .00 .13.16 1.0000 15 .04 .04 5.00 .00 .00 13.50 80.000 15 .00 0.00 12.00 .00 0.00 13.50 80.000 10 15.40 13.40 13.40 13.40 100.00 10 10 19.40 42.27 75.46 51.70 38.41 44.94 | 1,0000 | 15 1.41 1.41 15.00 3.29 .00 13.18 5 .66 .66 .66 .45 5 .66 .60 .60 12.60 .60 13.50 80 15.99 33.62 60.53 41.36 30.73 51.97 100 19.98 42.27 75.66 51.70 38.41 64.96 | • | • | 13.42 | 15.00 | 0 7 | 5 5 5 7 | 5 1 0 | - | 202.1 |
| 1.0000 5 .66 .66 .45 .45 .45 .45 .80 .66 .45 .45 .80 .60 1.56 1.10 .80 .80 .80 .80 .80 .80 .80 .80 .80 .8 | 1.00.00 5 .66 .66 .66 .45 .45 1.00 .60 .66 .45 1.00 .5 1.56 1.10 .5 1.10 .5 1.00 .5 1.56 1.10 .5 1.00 .5 1.56 1.10 .5 1.00 .5 1.56 1.50 1.550 .5 1.00 .5 1.5 1.00 .5 1.5 1.00 | 1.00.00 5 .66 .66 .45 .45 .45 .45 .50 .00 .66 .45 .50 .00 .56 .110 .56 .110 .50 .00 .50 .50 .50 .50 .50 .50 .50 .5 | 1.0000 5 .46 .46 5.60 .00 .46 .45 50.000 15 4.00 12.00 .00 15.60 11.10 50.000 15 4.00 12.00 .00 13.50 80.000 80 15.99 33.82 60.53 41.36 30.73 51.97 100.00 100 19.98 42.27 75.66 51.70 38.41 64.96 | \$.66 .66 .45 \$ 1.56 1.56 5.00 .00 1.56 1.10 15 4.00 4.00 12.00 .00 6.00 13.50 80 15.99 33.62 60.53 41.36 30.73 51.97 100 19.98 42.27 75.66 51.70 38.41 64.96 | - | 0 | 3.20 | 15.00 | 7 |) | | | 155.3 |
| 1.00.00 5 1.56 1.56 1.10 50.000 15 6.00 12.00 .00 6.00 13.50 80.000 80 15.09 33.62 60.53 41.36 30.73 51.97 100.00 100 19.00 42.27 75.66 51.70 38.41 64.94 | 1.0000 | 1.00.00 | 100.00 15 1.56 1.56 1.10 50.000 15 4.00 0.00 0.00 0.00 0.00 100.00 100 17.98 42.27 75.66 51.70 38.41 44.94 | 100 19.98 42.27 75.66 51.70 38.41 64.96 | | | 00. | 5.03 | 49. | 99. | 5 | | 1.000 |
| \$0.000 15 \$.00 \$.00 12.50 .00 \$.00 13.50 80.000 80 15.99 33.62 60.53 41.36 30.73 51.97 100.00 100 19.98 42.27 75.66 51.70 38.41 64.94 | \$0.000 15 6.00 6.00 12.50 .00 6.00 13.50 80.000 80 15.09 33.62 60.53 41.36 30.73 51.07 100.00 100 10.00 42.27 75.66 51.70 38.41 64.96 | 50.000 15 4.00 4.00 12.50 .00 4.00 13.50 80.000 80 15.99 33.62 60.53 41.36 30.73 51.97 100.00 100 19.98 42.27 75.66 51.70 38.41 64.96 | 50.000 15 4.00 4.00 12.50 .00 4.00 13.50 80.000 80 15.09 33.02 41.36 30.73 51.07 100.00 100 19.00 42.27 75.66 51.70 38.41 44.00 | 15 4.00 4.00 12.00 .00 6.00 13.50 80 15.79 33.62 60.53 41.36 30.73 51.97 10G 19.98 42.27 75.66 51.70 38.41 64.96 | - | _ | • 60 | 5.00 | 1 • 5 6 | 1.56 | <u>.</u> | | 1.000 |
| 100.00 100 19.90 42.27 75.66 51.70 38.41 64.90 | 100.00 100 19.98 42.27 75.66 51.70 38.41 64.96 | 100.00 100 19.78 42.27 75.66 51.70 38.41 64.96 | 100.00 10G 19.98 42.27 75.66 51.7G 38.41 64.94 | 10G 19.98 42:27 75:66 51.7G 38.41 64.96 | 13. | • | | 12.60 | 00.9 | | • | | 20.00 |
| 100.00 100 19.00 42.27 75.66 51.70 38.41 64.06 | 100.00 106 19.98 42.27 75.66 51.70 38.41 64.96 | 100.00 106 19.98 42.27 75.66 51.70 38.41 64.96 | 100.00 100 19.78 42.27 75.66 51.70 38.41 64.94 | 100 19.96 42.27 75.66 51.70 38.41 64,96 | 5 | 2 | _ | 60.53 | 33.62 | 64.6 | - | | 20.00 |
| | | | | | 9.0.00 | ļ | 51.70 | S, | | 1 | - 1 | | 100.0 |
| | | | | | ; ; | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | : | | 1 | | | | | |
| | | | | | | | | 1 | - | | | | |
| | | | | | | | | | | | | | |

*

| | | | | 2 | | | | | |
|--------------------------|--------|------------|---------|---|---|-------------------------------|--|---|---|
| | - | • | | : o, = | , " | • | | ina | |
| NORMAL | 10.01 | 42.27 | 75.66 | 51.73 | 36.41 | 96.99 | P | | |
| #£16HT | 21.90 | 46.90 | | 55.69 | 42.84 | 60.59 | | | |
| POACE | 18.27 | 38.65 | 77.74 | 54.93 | 35.11 | 86.49 | R | | |
| *OLUME | | 12.51 | 76.22 | D | 7 | 03+E/ | P QU | | |
| THENRAL DE | 40.01 | . 24.45 | 76.39 | 50.13 | 37.64 | 63.26 | A(JA | | |
| | | | 76.39 | 50 - 13 | 38.14 | • | | 1 | ı |
| DEV COST | | 42.08 | 76.03 | 47.27 | 36.54 | 67.10 | IE FY | | |
| | | | VITISHE | SISITIVITY ANALYSIS | | | | | |
| 1 1 1 | SINGLE | RATING FOR | 1 | EACH CONCEPT AF | 7 T T T T T T T T T T T T T T T T T T T | INCREASING G FACTOR BY +50 | | | |
| • | 1 | (BASED | 2 0 | # DO | N N N N N N N N N N N N N N N N N N N | | | | |
| | - | ~ | - | 2 0 7 U | CEPT | • | | | 1 |
| Jeweon | •••• | 42.27 | 15.66 | 51.70 | 38.41 | **** | | | |
| BE 1 GH? | 17.6 | 1 | 83.48 | 80.97 | 33.05 | 06.89 | | | |
| 205 207 207 307 | 27.05 | | 75.02 | 3 5 6 6 6 7 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 | | 66.44 | | | |
| THERMAL | 21.04 | | 170.14 | 54.78 | 42.38 | 62.59 | | | |
| RELIABON | () | ? | 74.67 | 53.37 | 39.22 | 62.76 | The same of the sa | * | |
| | ~** | 74.25 | 18071 | 7 | | 77.08 | | | |

SENSITIVITY ANALYSIS

| | 41 x 12 x 13 13 13 13 13 13 13 13 13 13 13 13 13 | • | (02/01/75) | .75) | 744-146 | | S I NO W | NG (SPACE | STATION) | 1 4 1 | 1 | T c | : | |
|-----------|--|--------|------------|-------|---------|-------|----------|-----------|----------|-------------|------------|------------|---|---|
| 1 | • | | i | | | | Í. | | • | | i . | | | |
| ; | 2 1 | HAR | | | | j | 200 | - 4 | ļ | | | | | |
| FACTOR | VALUE | AALUE | P.15 | - | ~ | ~ | • | in. | • | | | | | |
| DE1647 | 22.247 | 1294.0 | 51 | 4.36 | 24 + 1 | 000 | 14.74 | 13.52 | 86.6 | † † | | 1 | | |
| _ | | 355.00 | 5 | 00. | 00. | 15.00 | 13.42 | 00. | 4.78 | | | | | |
| AOT CAE | 1 - 7050 | 202012 | - | 00. | 4.74 | 8.53 | 9.92 | 8.99 | 3.97 | | | | | • |
| THERMAL | 00000 | 155.30 | 15 | 1+•1 | | 15.00 | 3.29 | 00. | 13.18 | | | | | į |
| REL 148-7 | .47:62 | 1.0000 | S | .64 | ÷ 9 • | 5.00 | 00. | 70. | 73. | | | | | |
| PAINTERE | **** | 1.000 | . | 1.56 | 95.1 | 5.00 | .00 | 1.54 | 01.1 | | , | | | |
| 1051 | 5.0000 | 50.000 | 5 1 | 00.4 | 6.03 | 12.00 | 00. | 9 • 00 | 13.50 | | | | | |
| C05T | 1.5650 | 1270.0 | 15 | 7.28 | 63.41 | 000 | 86.41 | 14.53 | 10.37 | | , | , | | |
| TOTAL PT | 00000 | 45.000 | \$ | 23.24 | 40.69 | 60.53 | 56.34 | 45.23 | 62.32 | | | | | |
| RATING | • 60000 | 100.00 | 100 | 24.46 | 51.25 | 63.71 | 59.31 | 47.61 | . 65.60 | | ORI | | | |
| | | : | : | | • | | | | | 1 | GII PC | | | • |
| į. | | | | | | , | | | | ! | NAI XOR | • | 4 | |
| | | | | : | | | | | | | PA | , | | |
| | | | | | | | | | | · | | ~ 1 | | |
| ! | | | | | 1 | , | | | | | T | *** | | |

Ÿ

TO COOLANT (LB/BTUH) .0540
HEAT LEAK (L8/8TUH) .1280
TYPE 1 .71C0
TYPE 2 .5910

NUMBER OF DAYS = 1826.0 (5.00 VEUSES FOD AURROUTINE 6
THERMAL PENALTY = DIRECT TO COOL
THERMAL PENALTY = CABI': MEAT LEA
PONER PENALTY (LBS/MATT) TYPE 1

. 1826.0 (5.00 VEARS)

(

| # \$ \$1.25 6 3.71 Se 5 3.41 Se 5 3.55 6 4.57 6 6 3.55 6 4.57 6 6 3.55 6 6 3.55 6 6 3.55 6 6 3.55 6 6 6 3.55 6 6 6 5.55 6 | | | | | | | | | | | • | | | |
|---|----------|-----------|--------------------|-------------|-------------------------------------|----------|---------------------|----|-------------|--------|---|---|--------|---------------|
| 29.46 \$1.25 63.71 \$9.31 47.61 65.60 22.67 47.50 66.7 61.51 49.13 65.57 23.24 53.56 64.77 61.51 49.72 64.31 23.34 48.19 64.37 64.57 47.19 64.48 24.17 50.27 64.67 47.19 64.14 25.60 50.43 64.90 54.97 47.19 64.48 25.60 50.43 64.90 54.97 47.19 67.39 26.22 54.77 59.05 62.28 51.21 65.85 26.22 54.77 59.05 62.28 51.21 65.85 26.22 54.77 59.05 62.28 51.21 65.85 26.24 56.57 66.57 26.25 54.77 59.05 62.28 51.21 65.85 26.26 51.25 63.77 59.31 47.61 65.60 22.03 47.39 69.17 55.97 43.97 65.52 26.56 55.64 66.5 56.77 61.69 25.78 54.84 60.00 62.51 57.09 45.26 67.04 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 25.78 52.29 62.73 60.91 43.55 67.14 | | | 1 | • | : □ ♥ J | 4 | • | ** | | | | | | |
| 25.78 54.55 59.05 62.16 50.72 65.67 23.24 47.50 66.77 61.51 44.13 65.57 23.36 48.19 66.37 56.57 44.13 67.23 24.63 50.27 64.64 57.79 44.13 67.23 24.63 50.73 64.90 57.94 47.19 64.48 25.60 50.43 64.90 57.97 47.05 67.39 26.22 54.77 59.05 62.29 51.21 65.85 26.22 54.77 59.05 62.29 51.21 65.85 26.22 54.77 59.05 62.29 51.71 65.85 26.22 54.77 59.05 62.29 51.71 65.85 26.22 54.77 59.07 47.55 26.22 54.77 59.07 45.26 67.04 25.46 51.25 63.71 59.31 47.61 65.60 25.72 54.86 60.60 62.51 57.09 45.26 67.04 25.72 52.73 60.07 60.07 63.57 25.72 54.86 60.60 62.51 57.09 45.26 67.04 25.72 52.73 60.01 40.05 66.73 27.72 52.73 60.01 40.05 66.73 | ı | 34.46 | \$1.25 | 63.71 | 54.31 | 19.4 | 09.59 | : | | 1 | 1 | | ! | |
| 22.67 47.50 44.77 61.51 44.13 65.57 23.24 53.56 44.77 61.50 44.13 65.57 23.24 53.56 44.77 61.50 49.72 64.23 24.17 50.27 64.64 57.77 44.13 67.23 24.17 50.43 64.90 54.97 47.17 64.48 25.60 50.43 64.90 54.97 47.17 64.48 25.60 50.43 64.90 54.97 47.05 67.39 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.26 50.77 50.05 62.28 51.21 65.80 22.93 47.39 60.17 55.87 43.97 65.52 26.56 55.64 60.65 56.72 51.67 65.63 25.72 48.60 62.51 57.09 45.26 67.04 25.72 54.84 60.60 62.51 57.09 45.26 67.04 25.72 54.84 60.60 62.51 43.55 67.14 27.28 52.29 62.77 60.91 43.55 67.14 27.28 52.29 62.77 60.91 43.55 67.14 | • | 25.78 | 54.55 | 50.05 | 42.16 | 50.72 | | | | | : | | 4 | ł. |
| 23.24 53.56 44.77 61.30 47.72 64.31 23.36 48.17 64.54 44.13 67.23 24.17 50.27 64.64 57.77 44.13 67.23 25.60 50.43 64.04 57.77 47.15 64.14 24.25 50.73 50.05 52.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.24 51.25 63.71 50.31 47.61 65.60 22.45 51.25 63.71 50.31 47.61 65.60 22.45 51.25 63.71 50.31 47.61 65.60 22.45 51.25 63.71 50.77 51.67 65.63 25.76 54.84 60.65 56.77 51.67 63.64 25.76 54.84 60.60 62.51 51.07 63.64 25.76 54.84 60.60 62.51 51.07 63.64 25.76 54.84 60.60 62.51 51.07 63.76 25.76 54.84 60.60 62.51 51.07 63.76 25.76 54.84 60.60 62.51 51.07 63.76 25.76 54.84 60.60 62.51 43.55 67.14 25.77 63.72 64.35 43.55 67.14 | , | 22.67 | 47.50 | 1 | | 4**10 | 65.57 | | | | | | | |
| 23.36 48.17 60.37 50.37 46.72 64.14 24.63 50.73 64.04 57.79 46.72 25.62 50.73 64.09 57.79 47.05 67.39 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.22 54.77 50.05 62.28 51.21 65.85 26.46 51.75 63.71 50.31 47.61 65.60 22.03 47.30 67.17 55.77 43.07 65.52 26.56 55.64 67.65 56.72 51.67 65.63 25.76 54.84 60.60 62.51 51.07 63.56 24.78 52.29 62.77 60.91 43.55 67.14 24.78 52.29 62.77 60.91 43.55 67.14 25.78 52.29 62.77 60.91 43.55 67.14 25.78 52.29 62.77 60.91 43.55 67.14 25.78 52.29 62.77 60.91 43.55 67.14 25.78 52.29 62.77 60.91 43.55 67.14 25.51 51.75 63.77 60.91 43.55 67.14 | | 23.24 | 53.56 | 44.74 | 61.30 | ~ . | | | | | | | | |
| 24-17 50-27 64-64 57-77 66-72 64-48 24-63 50-73 64-90 54-97 47-05 67-39 25-60 50-43 64-90 54-97 47-05 67-39 26-22 54-77 59-05 62-28 51-21 65-85 26-22 54-77 59-05 62-28 51-21 65-85 847186 FOR EACH CONCEPT AFTER INCREASING 8186LE SELECTION PARAHETER REIGHTING FACTOR BY AS 1 2 3 4 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | | 23.36 | - 1 . 8 . | - F • 9 9 | 56.57 | 7 | ' | | | | 1 | 1 | | |
| 24.63 50.73 64.90 54.97 47.05 47.39 24.22 54.77 59.05 62.28 51.21 65.85 24.22 54.77 59.05 62.28 51.21 65.85 RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAHETER REIGHTING FACTOR BY AS 18.46 51.25 63.71 59.31 47.61 65.60 22.63 47.39 69.17 55.97 43.67 65.52 26.56 55.64 60.65 56.72 51.67 65.63 25.82 48.69 62.51 57.09 45.26 67.04 24.78 52.29 62.77 60.91 43.55 67.14 24.78 52.29 62.77 60.91 43.55 67.14 24.78 52.29 62.77 60.91 43.55 67.14 24.78 52.29 62.77 60.91 43.55 67.14 | | 24.17 | 50.27 | **** | 57.79 | N 0 | | | | | | | | |
| 24-22 54-77 57-05 62-28 51-21 65-85 Z4-22 54-77 57-05 62-28 51-21 65-85 RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY m5 1 2 3 4 4 7 5 4 4 7 5 4 4 3 4 4 5 5 6 7 6 4 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | | 74.63 | 20.7 | 700 | 57.07 | 11.0 | | | | ! ! | , | | • | |
| SENSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER ASIGHTING FACTOR BY "S 18 | | 00007 | 7,000 |) 4 - (| 44.4 | | 7 4 | | | | | | | - |
| SENSITIVITY_ANALYSIS RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY MS (BASED ON 100 B MAN POINTS) (BASED ON 100 B MAN POINTS) 22.446 S1.25 63.71 54.31 47.61 65.60 22.45 47.34 60.60 62.51 51.67 65.63 25.76 54.84 60.60 62.51 51.67 63.64 24.28 52.27 62.73 60.91 43.56 67.14 24.28 52.27 62.73 60.91 43.56 63.53 24.28 52.27 62.73 60.91 43.56 63.53 24.28 52.27 62.73 60.91 43.56 63.53 | | í | | | | 1 | : | | | | | | | . 1 |
| SINGLE SELECTION PARAMETER AFITER INCREASING (BASED ON 100 % MAX POINTS) (BASED ON 100 | ı | 1 | Ŀ | | | | , | | | | 1 | | |). <u>`</u> , |
| SINGLE SELECTION PARAMETER RESIGNTING FACTOR BY "S 18 SELECTION PARAMETER RESIGNTING FACTOR BY "S 18 SELECTION FARAMETER RESIGNTING FACTOR BY "S 19 SELECTION TO BE AND POINTS! 22.03 A7.39 69.37 50.31 47.61 65.60 22.03 A7.39 69.37 55.67 43.97 65.63 25.36 55.64 60.65 56.72 51.67 65.63 25.36 55.64 60.65 56.72 51.67 65.63 25.36 55.84 60.65 56.72 51.67 65.63 25.36 55.89 60.60 62.51 51.09 63.56 24.28 52.29 62.73 60.91 43.56 63.58 24.28 52.29 62.73 60.91 43.56 63.58 | | | • | | 7 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 | - 616191 | | | | | | | | • , ! |
| 22.04 | , | .Indle | ATING F SELECTI | OR EACH | CONCEP R | | INCREAS G FACTOR | ۲, | | | : | , | | , (', ' |
| 24.46 51.25 63.71 54.31 47.61 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 51.67 65 25.72 67.73 | • | | 1845 | 1 NO Du | 7 × 00 | | | | | | | | | ! |
| 24.46 51.25 63.71 59.31 47.61 65 22.63 47.39 69.17 55.67 43.97 65 25.52 48.69 62.51 57.09 43.52 67 22.73 52.29 62.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 67 23.73 60.91 43.55 68 23.73 60.91 43.73 60. | | - | } | ? | 2 0 * | | • | | ; ; ; | | | ! | , | : |
| 28-63 47-34 69-17 55-77 43-77 65- 26-56 55-64 40-65 56-72 51-67 65- 25-32 48-69 62-51 57-09 45-26 67- 25-76 54-84 60-60 62-51 51-59 67- 24-78 52-27 62-73 60-71 43-55 67- 24-28 51-87 62-73 60-71 43-55 65- 24-28 51-87 62-73 64-39 48-56 65- | د. | 34.46 | 51.15 | 63.71 | 50.31 | 17.61 | 9.54 | | | | | : | | |
| 25.82 48.66 62.51 57.09 45.26 67. 25.76 54.84 60.60 62.51 51.89 63. 24.78 52.29 62.73 60.91 40.55 67. 24.28 51.89 62.73 60.91 40.56 66. | i | 22.03 | | | 55.47 | | 65.52 | | | | | | | |
| 25.76 54,84 60.60 62.51 51.59 63.4 24.78 52.29 62.73 60.91 40.55 67.1 24.28 51.80 62.73 60.91 40.06 66.7 23.13 62.22 62.32 64.39 40.26 63.5 | | 25.82 | | 62.51 | 57.09 | | 7 O • K • | | 1 | | | | | |
| 24.78 52.29 62.73 60.91 40.55 57.1 24.28 51.81 62.17 60.71 40.06 66.7 23.13 62.22 62.32 64.39 48.26 63.5 | | 25.76 | 54,84 | 00.00 | 15:29 | | - | ! | | 4 | | | | |
| た。のの のじゅつぎ | | 2 * * 7 8 | 52.29 | 62.73 | 16.09 | | 1 | | | | | | | |
| ************************************** | <u> </u> | | 51.87 | 62.30 | 1:00 | 0 | V . 4 | 1 | | : | | | i • | 1 |
| OSO PROUS MENTS. Props Annual Editor | | 23.13 | 77.75 | 77.74 | ٦ • | • | • | | | | | | | |

SENSITIVITY ANALYSIS

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 2.2.2-PARTIAL BODY WASHING

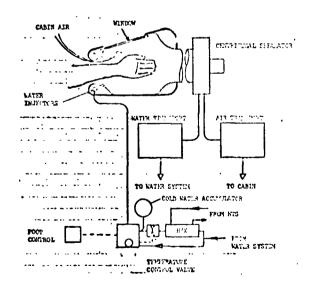
CRITICAL NUMBER OF SAFETY ITEMS 9010F S AVENE BEFIEL Z ш НЕЛТЕВ z 0 ANNOAL VALVE ۵ \mathbf{z} 0 dWNd ပ ΛVΓΛΕ CHECK CCHTROLLER TIMER 0 SCONTROL VALVE œ ш B ACCUMULATOR Σ **..**.) EXCHANGER HEAT NVCNE 20CEHOID LILTER (e) MATER SEPARATOR 0 COMPCHENT TYPE DISPOSABLE WASHCLOTHS (SKYLAB) AUTOMATIC SPONSE (ASTRO-VAC) DISPOSABLE WET WIPES REUSABLE WASHOLOTHS REUSABLE WET WIPES DISPOSABLE WIPES APPLIANCE TYPE

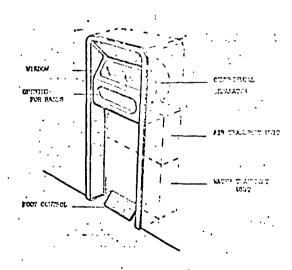
D2 1121-11 3

| SPACECRAFT | Space Station | |
|--------------------|---------------------|---|
| HABIT ABILI | ITY SUBSYSTEM Perso | onal Hygiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE | FUNCTION Partial | Body Washing |
| APPLIANCE | CONCEPT NO./TITLE_ | 1/Disposable Wet Wipes |
| INDEX NO | 2.2.2.1 | REF. NO236, 186 |
| | | • |

DESCRIPTION

The disposable wet wipes concept is a sponge bath technique used to clean local areas of the body. A wetting and soaping unit, with hand holes is supplied for the function. The unit has a water supply outlet, a storage area for soap and a fan for providing water entrainment during use. A centrifugal separator is provided upstream of the blower to collect used water. Water temperature is controlled by mixing hot with cold water in a temperature controlled mixing valve. The crewman first "soaps up" the wipe in the wetting unit, then uses it to clean the required areas of the body. The wipe is wrung out and rinsed inside the wetting unit. The rinsed damp wipe is used to wipe excess soap from the body. A final rinse and wringing out of the wipe is accomplished and the wipe is disposed of by depositing it into a vacuum drier to emove excess water. The dried wipe is then deposited into the refuse system. The disposable wipes are 12 inch squares of 4 ply wet strength paper, 10 of which are supplied per crewman per day.





D2-11850174

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS

CONCEPT 1/DISACISMBLL WET WIPES

INDEX NUMBER 2.2.2.1

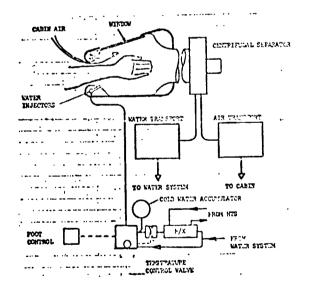
| | ELECI | | POWER C. POWE | | <u> </u> | C POWI | |
|-----------------|-----------------------------|-----------------------------|------------------------------|---------------------------------------|--------------------------|--------------------|----------------------------------|
| COMPONENT (REF) | USE TIME CYCLE (HR) 0375 | ② PEAK (WATTS) 500 | 3 AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X (3) 13.5 | E) PEAK (WATTS) | 6) AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) (D X (7) |
| • | | | | | | | • |
| | | 500 | | 13.5 | | • | |
| ٠. | | MAXIMUM . | • | TOTAL | MAXIMUM | | TOTAL |
| | Ī | HERMAL. | | <u>REMENTS</u> | HEAT LEAK | 7.0 |) COOLANT |
| SOURCE | | (BTU/HR) | | U/HR) | (BTU/HR) | | (BTU/HR) |
| MATGR HEAT LO | | 360 | | 48 | 948 | | 360 |
| mo. u.s. | | | | | | | |
| 1 | | 05.6 (360 IATT (BTU/HR) | , | <i>3 (943)</i> (BTU/HR) | 278 (94) WATT (BTU/HR | , | 56 (360) T (BTU/HF) |
| • | | ٠ | • | | | | |
| ·· ' · · | <u>o</u> <u>F</u> | PERATIO | NAL PE | NALTIES | <u>i</u> | | |
| SOURCE | HEAT L | | TO COOLANT ITU/HR/CYCLE) | ELECTRICAL (PK WATTS/CY | | | VOLUME (3/MISSION) |
| | | | | | | | |
| . тот | AL WATTS/ | CYCLE (| WATTS/CYCLE BTU/HR/CYCLE) | | KG/MISS (LB/MISS | 104 M ³ | JM12210X) W12210X |

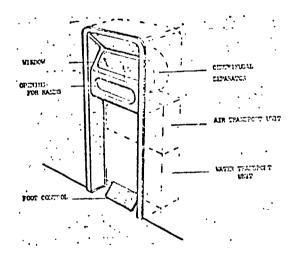
| ONCEPT 1/11/2016. L | APPLIANCE CONCEPT REQU | TREMENTS AND PENALTIES CAU | | NUMBER 2.2.2.1 |
|--|--|--|-------------------------------|--------------------------------------|
| | <u>FIXED</u> <u>WEIG</u> | HIVOLUME REG | <u>LUIPEMENTS</u> | |
| OMPONENT | (REF) (236) | WEIGHT (LBS) 76.69 165.6 | · · | VOLUME (FT3) 185 |
| OLYDANIC WIF | <u> </u> | 165.6 | | 16.56 |
| | | | | |
| | | · · · · · · · · · · · · · · · · · · · | | |
| | TOTAL · | 109.9 (242. | 70) | 5:7 (201.56) |
| | · | KG (LBS) | <i>-</i> . | 5:7 (201.56) M³ (FT³) |
| | TS/CYCLE(REF) (PKG.W | A B L E W I/V O L ② ③ NIT (REF) WT/CYCL T/UNIT)(REF) ① X② (LB) (LB) Q15 (233) Q15 | (PKG.VOL/UNIT) (FT³) | |
| | | | | |
| | | ∑30/5 TOTAL WT/C (LB) | YCLE . S | OO/5 TOTAL VOL/CYCLE (FT1) |
| TAL WT. ISS FOR CYCLES/DA | x 194 y DAYS/MISSI | TOT.WT/CYCLE (LE) | _ • | 15.1 (165.6) |
| TAL VOL | x 184 Y DAYS/MISSI | | • | 469 (16.56) N ^J (11.7) |
| <u>6</u> | <u>A S/L 1 Q U 1 D </u> | <u>CPENDABLES</u> R | EQUIREMENTS | |
| TYPE | AMT. USED/CYCLE (REF | RECOVERY FACTOR | AMT.RECOVERED/CYCLE OX (LB) | AMT LOST/CYCLE (LB) |
| DXYGEN (WHI DISAZ) VATUR LOSS (LOSS | .0444 | | N/N .9995 | .000719 |
| N DISMOSCU WIPE | <u> </u> | | | |
| . Σ | 0 .545 | • | Σθ | .0456 |

| SPACECRAFT Space Station | · | , | |
|-------------------------------|--------------------------|---------------|-------------|
| HABITABILITY SUBSYSTEM Person | nal Hygiene HABITABIL1TY | FUNCTION Body | / Cleansing |
| APPLIANCE FUNCTION Partial | Body Washing | | <u></u> |
| APPLIANCE CONCEPT NO./TITLE | | | |
| INDEX NO. 2.2.2.2 | REF. NO. | 236, 186 | |
| THULK HO. | | | |

DESCRIPTION

The reusable wet wipe concept is a sponge bath technique used to clean local areas of the body. The wetting unit described in Concept 1 is also required for this concept. The reusable wipes, however, are wrung out in the wetting unit and reused. Reusable wipes are provided on a per man basis. The wipe is washed and dried using a washing machine and dryer. After 60 washings, the wipe is discarded and replaced. The reusable wipes are 10 inches square of 4 ply "wet strength" paper.





D2-118561-74 APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS CONCEPT Z/REUSABCE WEF WIPES

INDEX NUMBER 2.2.2.2

| Ē. | L | Ē | Ē | Ī | R | 1 | Ç | <u>A</u> | Ţ | <u>P</u> | 0 | W | 1 | £ | R | ! | Ŗ | Ē | g | Ņ | 1 | R | Ē | M | Ĺ | Ñ | <u>T</u> | <u>5</u> | |
|----|---|---|---|---|---|---|---|----------|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|----------|--|
|----|---|---|---|---|---|---|---|----------|---|----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------|----------|--|

| | • | A (| C . POWE | | D | C POWE | |
|---|----------------------------|----------------------|-------------------|---|----------------------|-------------------|---|
| COMPONENT (REF) | USE TIME CYCL'E (HR) | ② PEAK (WATTS) | ③ AVERAGE (WATTS) | (4) DEMAND (WATT-HR/ CYCLL) ① X ③ | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WATTS) | (7) DEMAND (WATT-HR/ CYCLE) ① X ② |
| WCTTHIS PHIT (236) | .0375 | 500 | _361_ | 13.5 | | - | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| *************************************** | | 500 | • | 13.5 | | • | • |
| | | MAXIMUM . | | TOTAL | MAXIMUM | | TOTAL |

<u>R E Q U I R E M E N I S</u> IHERMAL

| SOURCE | LATENT (BTU/HR) | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
|-----------------|-------------------------------------|----------------------------|----------------------------|------------------------------|
| WATER HUBT LOSS | _360 | 948 | <u> </u> | <u>360</u> |
| | | | | |
| | | | | |
| \ TOTAL | <u>105-6 (360)</u> watt (btu/hr) | 278 (949) WATT (BTU/HR) | 278 (449) WATT (BTU/HR) | 105.6 (360) WATT (BTU/HP) |

OPERATIONAL PENALTIES

| SOURCE | TH HEAT LEAK (BTU/HR/CYCLE) | ERMAL' TO COOLANT (BTU/HR/CYCLE) | ELECTRICAL (PK_WATTS/CYCLE) | WEIGHT (LB/MISSION) | VOLUME (FT ³ /MISSION) |
|-----------------|--|----------------------------------|-----------------------------|---------------------------------------|--------------------------------------|
| WASHER DRYCR | 164 | | <u>7.74</u> <u>9.78</u> | _6.54 _2.62 | .584 .565 |
| , | 51.6 | 6.48 | | 4.15 | .033 |
| • | TOTAL (175.9) NATIS/CYCLE (BTU/HR/CYCLE) | WATTS/CYCLE (BTU/HR/CYCLE) | 17.52 | (19.16) KG/MISSIGN (LB/MISSIGN) | Mymission (F1)/mission |

| _ | T | • | • |
|---|---|---|---|
| | | • | |
| | | | |
| | | | |
| | | | |

| OMPONERT | (REF) | WEIGHT (LBS) | | VOLUME (FT3) |
|--------------------------------|--|--|------------------------------|-------------------------------------|
| WLTTING UNIT BOUSIBLE WIPLS | (236) | 28.49 73 | ζ, | 3.5 .464 |
| | | | | |
| | | | | |
| | | | | |
| | ar a later again de la desarch ann ann an an ann ann an an ann an ann an a | | | |
| | | | | |
| | TOTAL | 13.26 (29. | .226) | 7/2 (3.964) M` (FT³) |
| <u>\$ 0</u> L | • | ② ③ | REQUIREMENTS (4) | |
| TYPE UNIT | (PKG.) S/CYCLE(REF) | JNIT (REF) WT/CYG WT/UNIT)(REF) ①X((LB) (LB | CLE | VOL/CYCLE (F) (1) X (4) (F13) |
| | (67 (2%) | | 1648 .00252 (| 26) .000012 |
| | | | | |
| | | | | |
| | | | | |
| | | Σ3.σως. | | D 0000121 |
| | • | DO TOTAL WI | Titule - | (FT*) |
| TOTAL MT. MISSION CYCLES/DAY | xx | X <u>6000</u> Sign X 101.817.CYČ (Le) | (2: | 834 (.75G) |
| MISSIUN 60 CYCLES/DAY | x184 vays/mis: | SION X TOT. VOL. /CY | 27 - 0 | 13 (.464) |
| . <u>G</u> <u>A</u> | <u>5/L 1 Q U 1 D</u> <u>E</u> | X P E N D A B L E S | <u>REQUIREMENTS</u> | • |
| • | Φ | RECOVERY | AMT. RECOVERED/CYCLE | AMT LOST/CYCLE |
| TYPE | AMT. USED/CYCLE (R (LB) | FACTOR | ①x() (LB) 4 995 | · (1.B) |
| WATER WASHER WATER | | (3L) <u>10009</u> | | .0005 |
| COSS PLANCTY | .36 | 10009 | 3597 | |
| | | | | |
| 50 | D .86 | • | Σ@ | .000824 |
| 2 | | | - | |

(Lt)

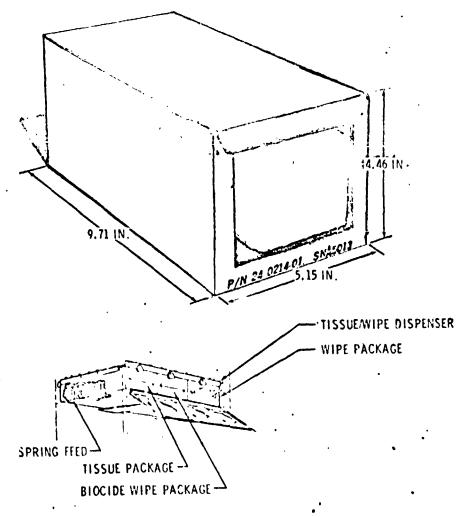
(z (1)

| SPACECRAFT Space Station | |
|-------------------------------|---|
| HABITABILITY SUBSYSTEM Person | al Hygiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION Partial | Body Washing |
| APPLIANCE CONCEPT NO./TITLE_ | 3/Disposable Wipes (Skylab) |
| INDEX NO. 2.2.2.3 | REF. NO. 250, 283 |

DESCRIPTION

The disposable wiper concept is made up of prepackaged wipes which were used on Skylab. The wipes are contained within a package to eliminate water evaporation during storage. The units are used and discarded. The Skylab size wipe weight and volume were ratioed (6.3) to the 10 inch square wipes used in Concepts 1 and 2 in order to provide an equivalent trade.

Wipe Dispenser



D2418561-4

| concret 2 / 191. pr. | L'APPLIA | nct concert legal Michigan | remais Mid P | ENALTIES CALCO | ATTICLES INDEX | NUMER Z | 223.2.1 |
|--|--------------------------|-------------------------------|-----------------|--|-----------------------|---------|--------------------------|
| | E F F C | ȚRICAL P | 0 W F R | ŖĔQIJĬŖĔ | неить | | |
| | (1) USE TIPE CYCLE | (7) | POWE AVEPAGE | DEMAND (WATT-HRZ | (5) PEAK | (6) | DEMAND WATE-HR |
| COMPONENT (PEF) | (HR) | (WATES) | (WATTS) | (1) X (3) | (WATIS) | (WATTS) | (DX() |
| | | | | | | | |
| ride de ande de distriction de de l'agric de desarrais de l'agricolar de l'agrico | | The Reservoir Control | | | | | |
| | | | | a a mar afficiação referencias com el | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| • | | | | | | | |
| • | | MUNIXAM | | TOTAL | MAXIMUM | | TOTAL |
| | | | | | | | |
| | • | • | • | | | | |
| | | THERMAL | R E Q U I F | REMENIS | | | |
| SOURCE | • | LATENT (BTU/HR) | | SIBLE J/HR) | HEAT LEAK (BTU/HR) | | O COOLANT (BTU/HR) |
| 1/1 | | | | | | | |
| , | | | | g gggfm - kenn kalipun (fil) k h | | | |
| | | | *** | ···· | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | TOTAL | | | | | | |
| • | | WATT (BTU/HR) | WATT (| CTU/HR) | WATT (BTU/HR) |) WA | IT (BIU/HR) |
| | | | | | | | |
| | | | • | | | | |
| • | | | • | • | | | |
| | | · | | | | | |
| | | <u> </u> | AL PE | NALTIES | | | |
| | | THERMAL | | C) CCTD1CA | WEIGH | • | VOLUME |
| SOURCE | | IT LEAK . TO |) COOLANT | ELECTRICAL (PK MATTS/CYC | | | T ³ /MISSION) |
| N/2. | | | | | • | | |
| <u>aaran kan dan dan dan dan dan dan dan dan dan d</u> | | | | | | | |
| | | | | | | | |
| | · | | | | | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | | |
| | | | | | | | |
| | TOTAL | rs/cycli [w | MTS/CYCLE | ************************************** | KG/M155 | 104 | Kotsetsty |

15

APPLIANCE CONCERT PEGNITHMENTS AND FENALTHS CALCULATIONS (CONCERDED)

CONCEPT 3/DISTRIBUTIONS (SKYLOS)

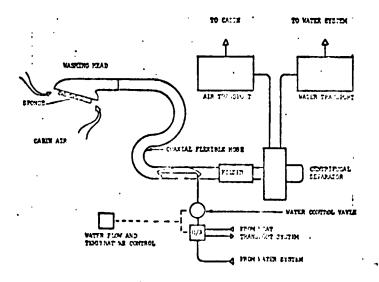
INDEX NUMBER 2 2.2.3

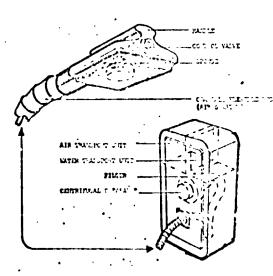
| COMPONENT WUS PA-KIISI | (REF) | 16 H J/Y OL P ME GER V J. P. F. (C.S.) | VOLUME (FT.) 29. B |
|--|-------------------|--|--|
| | TOTAL | 584.9 (1293.2) | .843 (29.8) |
| | O (F) | (7) (7) (7) (7) (7) (11) (12) (13) (14) (15) (15) (15) (15) (15) (15) (15) (15 | 1 R E M E N T S VOL/UNIT (FEF) (PKG, VOL/UNIT)(FEF) (FT3) (FT3) (FT3) (FT3) (FT3) |
| TOTAL WI. MISSION TOTAL VIL TRISSION CYCLES/ | | 101/1/2 101/1/2 101/1/2 (LB) 7 | \(\sum_{\text{10} \text{10} \text{70027}\\(\frac{1}{10\text{11}\text{10}\te |
| TYPE - N/A - | G A 5/L 1 Q U 1 D | EXPENDABLES REQUI | REMENIS CONTINUO (LB) CLB) CLB) CLB) CLB) CLB) CLB) |
| TOTAL KT MISSION - CYCLE/DAY | X | * TOTAL TOLITICALL * | Σ. ω ω ω ω ω ω ω ω ω ω ω ω ω ω ω ω ω ω ω |

| SPACECRAF | Space S | <u>station</u> | | | | |
|--|-----------|----------------|--------------------|----------|--|--|
| HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Body Cleansing | | | | | | |
| APPLIANCE | FUNCTION | Partia1 | Body Washing | | | |
| APPLIANCE | CONCEPT N | O./TITLE_ | 4/Automatic Sponge | | | |
| INDEX NO. | 2.2 | 2.2.4 | REF. NO. | 236, 100 | | |
| _ | | | | • | | |

DESCRIPTION

The automatic sponge concept is a hand-held scrubber head connected by coaxial flex tubing to a water supply valve and an air transport system. Water is fed into a sponge in the scrubber head for use in cleaning the body. A water pickup housing connected to the vacuum line surrounds the sponge. A water separator is used to collect water from the cabin air. A pump unit injects the water into the water waste management system. Each crewman has a sponge and is provided with one sponge per month to fit the scrubber head.





D2 41056[1]

APPLIANCE CONCEPT PEQUIPERENTS AND PENALTIES CALCIN ATIONS CONCEPT 4 [ASTERMIS : SALVACIC

INDEX NUMBER 2.7.2.4

| · | | IRICAL PO | WER POWE | | MENIS | P O W E | |
|--|---------------------------|---|-------------|--|-----------------------|---------|-----------------------------------|
| COMPONENT (REF) AUTOMATIC SPORTS UILLE (236) | USE TIME CYCLE (HR) -0375 | (WATTS) | (WATTS) | (A) DEM 1-10 / CYCLE) (D) X (D) [1.19] | (WATTS) | (WALTS) | (7) DEM/YU (WATI-RK/ CYCLE) ① x ② |
| | | 52:8 MAXIHUM . | • | | MAXIPUN | • | TOTAL |
| ٠. | | | | | | | • |
| SOURCE | | <u>I H E R M A L</u> <u>E</u> LATENT (BTU/HR) | SENS | THLE /HR) | HEAT LEAK (BTU/HR) | | COOLANI BTU/HR) |
| MOTERS | <u>.</u> . | 2160 | | 26.7 | 36.7 | | |
| \ | TOTAL | 6234 (2162) WATT (BTU/HR) | | 3 (2-7) BTU/HR) | 10.8 (36. | - | 3.9(2.160 (B1U/HR) |
| | | • | | | | | |
| source — N/A — | _ | THERMAL' LEAK TO CO (CYCLE) (BYU/HR | | NALTIES ELECTRICAL (PK WATTS/CY) | WEIGHT | | OLUME /MISSION) |
| | | | | | | | production of the sufference |

KG/MISSION (LB/MISSION)

NIVMISSION (FT VMISSION)

WATTS/CYCLE (BTU/HR/CYCLE)

TOTAL

WATIS/CYCLE (BTU/HK/CYCLE)

D2-1181-61-4 APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS (CONCLUDED) INDEX NUMBER 2.2.2.1 CONCEPT 4/12 MATIC PULL FIXED HEICHT/VOLUME REQUIREMENTS (LBS) AUTOMOTIC STENIC VIIT (236) 20.6 9.8 (21.69) TOTAL .047 M3 (FT3) . KG (LES) SOLID EXPENDABLE MI/VOL REQUIREMENTS MI/CYCLE UNITS/CYCLE(REF) .033 (234) .002489 .000986 .00048/ .0000159 SYONGES Σ ⑤ .0000/57

TOTAL (F1) Σ (101 kt hi/critte (18) 60 x /84 x .000996 . [.994 (1.09)]

EVELES/INAY DAYS/MISSIEN X .0009966 . KG (Lb) TOTAL VOL CYCLES/DAY X 184 X .000/59 ... REQUIREMENTS GAS/LIQUID EXPENDABLES 0 AMT . RECOVERED/GFCLE RECOVERY AMT. USED/CYCLE (REF) TYPE FACTOR WARK 05 (234) 1-,0009 Σψ ___05

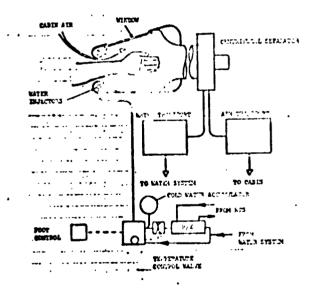
C2-254

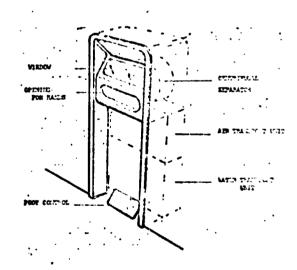
TOTAL MT. BAYS/MISSION 10TAL TUST/CICLE (LB) & DAYS/MISSION NOTAL TUST/CICLE (LB) & DAYS/MISSION NOTAL TUST/CICLE

| SPACECRAFT Space Station | The State of the State of Stat |
|------------------------------|--|
| HABITABILITY SUBSYSTEM Perso | onal Hygiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION Partial | |
| APPLIANCE CONCEPT NO./TITLE_ | 5/Reusable Washcloths |
| INDEX NO. 2.2.2.5 | PEF. NO. 236,237,245,209 |

DESCRIPTION

The reusable washcloths concept is the same as Concept 2; however, terry washcloths are used for cleansing cloths. The terry washcloths are 6 inches square. The washcloth is used for 60 washings then is discarded and replaced. The washcloth is washed and dried daily using a washing machine and dryer.





D2 113561 7

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT S/RELIMABLE WASHICLOTHES

INDEX NUMLER 2.2.2.5

| E | | | | | | | 1 | P | 0 | W | F | R | R | £ | 0 | U | 1 | P | Ε | M | £ | N | T | 5 |
|---|---|------|---|---|---|------|---|---|----|---|---|---|---|----|----|-----|---|---|---|-----|---|---|---|---|
| - | - | | _ | _ | - | | | - | •• | | _ | | | •• | ٠. | • • | - | | - | • ~ | - | | - | - |

| | • | A (| C . POWE | | D | C POWE | |
|-------------------|----------------------------|----------------------|-------------------|--|----------------------|---|-----------------------------------|
| COMPONENT (REF) | USE TIME CYCL'E (HR) | ② PEAK (WATTS) | ③ AVERAGE (WATTS) | DEMAND (WATT-HP/ CYCLE) (D) (3) | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WATTS) | (7) DEMAND (WATT-HR/ CYCLE) ① X ⑦ |
| WLTHING UNIT (ES) | .0375 | 500 | 361 | 13.5 | | | |
| | | | | | | | |
| | | | | • | | | , |
| | | | | | | | |
| | | | | | | | |
| | | | | | | *************************************** | |
| | | 500 MAXIMUM • | • | 13.5 TOTAL | MUMIXAM | • | TOTAL |

THERMAL REQUIREMENTS

| • SO URCE | LATENT (BTU/HR) | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
|------------------|--------------------|----------------------------|--------------------------------------|-----------------------------|
| WATER HUNT LOSS | 360 | 949 | 948 | _360 |
| | | | | |
| | | | marin Pillipin kali ilmani marini ka | |
| 1 101 | NATT (BTU/HR) | 278 (948) WATT (BTU/HR) | 278 (949) WATT (BTU/HR) | 105.6(360) WATT (BTU/HR) |

OPERATIONAL PENALTIES

| | • | | RMAL' | ELECTRICAL | WEIGHT | VOLUME |
|---|----------|--|--|------------------|--------------------------------------|-------------------------------|
| • | SOURCE | HEAT LEAK (BTU/HR/CYCLE) | TO COOLANT (BTU/HR/C:CLE) | (PK WATTS/CYCLE) | (LB/MISSION) | (FT ³ /MISSION) |
| WAS | HK-R | 990 | | 46. | 39.5 | 3.52 |
| DRYL | <u>R</u> | | 133.2 | _59 | 15.8 | 3.48 |
| | · | | • | <u> </u> | | |
| `\ | | | | | | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | 311.3 | | | 25.08 | .198 |
| | | TOTAL (IOCI.7) NATTS/CYCLE (BTU/IIR/CYCLE) | (133.2) WATTS/CYCLE (BTU/HR/CYCLE) | 1059 | (55.3) kg/MISSION (LB/MISSION) | (7.00) MYMISSION (FTYMISSION) |

D2-W350-A APPLIANCE CONCEPT PEQUIPERENTS AND PENALTIES CALCULATIONS (CONCLUDED)

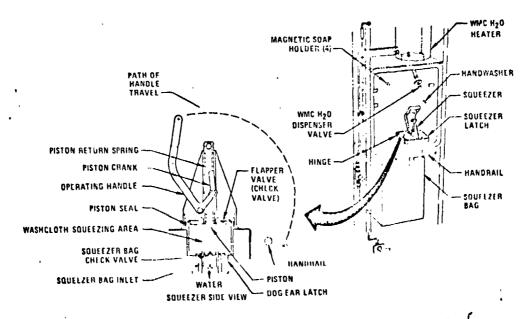
| APPLIANCE CONCEPT PEQUIPERENTS AND PENALTIES CALCULATIONS | (CONCLUDED) | |
|---|---------------|---------|
| CONCEPT 5/ RCU ABLE WASHOCOLINES | INDEX NUMBER_ | 2.2.2.5 |

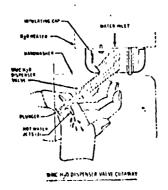
| MED WELD MED WELD (REF) (2.34) MOST CLOSHES | | MEIGHT (LUS) 29.19 14.10 | 018181813 | VOLUME (FT ²) 3.5 10.0 |
|--|----------------------|--|---|--|
| SOLI TYPE UNITS/ WINSH CLOTALS | O WT/L CYCLE(REF) | MBLE WI/VOL (CONIT (REF) WI/CYCI (LB) (LB) (CONIT (CONIT) (C | R E Q U I R E M E N I S E VOL/UNIT (REF) (PKG. VOL/UNIT) (RE | (FT ³) |
| TOTAL VOL CYCLES/DAY TOTAL VOL CYCLES/DAY CYCLES/DAY | x | (LB) | 6 | (14.1) S .00091 TOTAL VI /LYCLE (FT) KG (LB) (14.1) |
| TYPE WATER WASHER WATER LOSS PENNEY | | Ø DEGOVERY | EQUIREMENIS AMT.RECOVERTO/CYCLE (LB) - 4995 - 2.208 | AMT LOST/CYCLE (D-(3) (LB) |
| TOTAL WT. • 60 - CYCLE/DAY | 2.71_x | TOTAL LOST/CYCLE | ΣΦ 7.49 · 2.71 · | .002.49 13.7 (30.2) |

| SPACECRAFT Space Station | |
|-----------------------------|--|
| HABITABILITY SUBSYSTEM Per | sonal Hygiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION Part | ial Body Washing |
| APPLIANCE CONCEPT NO./TITLE | 6/Disposable Washcloths (Skylab) |
| INDEX NO. 2.2.2.6 | REF. NO. 236,283 |

DESCRIPTION

The disposable washcloths concept is the system used on the Skylab vehicle. The terrycloth washcloths are wetted by depressing a water supply valve. The unit will provide warm water from a heated storage tank. After the cloth is used, it is squeezed using a manual squeezer unit. The water squeezed from the washcloth is recovered and routed to the water waste management system. One washcloth is provided per man per day. The washcloths are disposed of by deposit into a vacuum drier to remove excess water. The dried cloth is then deposited into the refuse system.





D2-418-5/1-4

APPLIANCE CONCEPT PEQUIPEMENTS AND PENALTIES CALCULATIONS CONCEPT 6 [DISASSABLE CONSTITUTES OF THE CONTRACTOR OF THE CON

12

INDEX NUMBER 2,2.7.6

| · | ELECIE | | <u>0 </u> | <u>REQUIRE!</u> | 4 <u>E 9 T S</u> D C | POWE | Ď |
|--|----------------------------|--------------------------|--|-----------------------------------|---------------------------|----------------------|---|
| COMPONENT (REF) HUITEE (203) WALL IWAR | USE TIME CYCLE (HR) 0375 | PEAK (WATTS) | AVERAGE (WATTS) | (4) DEMAND (WATT-HR/ CYCLE) ① X ③ | (S) PEAK (WATTS) | 6 AVERAGE (WATTS) | (7) DEMAND (WAIT-MM/ CYCLE) ① X ① 5.25 |
| ••• | | 57.5 MAXIMUM | | 2.15 TOTAL | 140 MAXIMUM | • | 5.25 TOTAL |
| SOURCE | | HERMAL LATENT (BTU/HR) | SENS | E M E N I S IBLE /HR) | HEAT LEAK (BTU/HR) | (8 | COOLANT |
| WATER HEAT LOSS HEATER BUMP | , | //o | | 71.6 9,4 | 71.6 29.4 | | <u></u> |
| • | | 2.3(110) ATT (BTU/HR) | | E(1010) BTU/HR) | 29.6 (10.10 MATT (BTU/HR) | () <u>32</u> WATT | (BTU/HR) |
| | <u>0 P</u> | ERATION | AL PE | <u>N A L T 1 E S</u> | | | |
| \$0URCE | HEAT LI (BTU/HR/CY | THERMAL TO CLE) (BTU/ | COOLANT HP/CYCLE) | ELECTRICAL (PK WATTS/CYCL | MEIGHT (LB/MISSI | | OLUME /MISSION) |
| To | ral . | | | | | • | |

KG/MISSION (LB/MISSION)

(EL3/HI2210A)

WATTS/CYCLE (BTU/HR/CYCLE)

WATTS/CYCLE (BTU/HR/CYCLE)

D2.410.561.4 APPLIANCE CONCERT PEQUIPMENTS MID 10. THES CALCULATIONS (CONCURBE)

| TO THE CONTROL OF THE | THE STATE OF THE CONTRACT OF T |
|--|--|
| CONCEPT 6/21/12/18/18/18/18/19/19 | INDEX NUMBER S. Z. Z. Z. C. |

| COMPONENT SQUICZI I/WAI WASH CLOTHS | (REF) | WEIGHT (LES) 1.)32.4 | | VOLUME (FT') 1,15 120,6 |
|---|-------------------------|--|--|----------------------------------|
| | | | | |
| | TOTAL | 686.7 (15 | 7.4) 3. | 45 (121.75) |
| TYPE WASH COTHE | o ₩ | DAFLE WI/YOL O 3 I/UNIT (PEF) WI/CYC (LB) (LB) O 777 O 725 (763) | LE VOL/UNIT (REF) (PKG.VOL/UNIT)((FI1) | (S) VOL/C)(LE |
| TOTAL WT G MISSION - CYCLE | O X /8 | (18) | | (19) (19) (19) |
| TOTAL VOI MISSION - CYCLL | SOUTH X BOOKS | | · [<u>3</u> | 9.1 (125.6) |
| TYPE WATEK WATER LOSS SPACE | MT. USED/CYCLE((B)) | © PECONA IN | EQUIREME'IS AMT.RECOVERID/CYCLE (DX(2) (LB) 417.5 | AMT LOST/CYCLE ()-(3) (LB) |
| 7 | Σ0 .575 | | Σω | .0255 |
| TOTAL NT. CYCLLY | X 184 AY TAYS/HISMOF | TOTAL TOST/LITTLE | 81.5 · <u>.525</u> · | 127.9 (252.) |

1)> 11(11) 1

| HABITABILITY SUBSYSTEM 2.0 Personal Hygiene |
|--|
| HABITABILITY FUNCTION 2.2 Body Cleansing |
| APPLIANCE FUNCTION 2.2.3 Partial Body Drying |
| NUMBER OF CONCEPTS CONSIDERED 3 |

ASSUMPTIONS

- (1) The wipes and towels considered for partial body drying provide the means for drying local body areas after partial body washing.
- (2) Washer/dryer penalty was based on washer Concept 7, Water Spray Agitation, and dryer Concept 1, Forced Hot Air-Electric Dryer.
- (3) Vacuum drying, if used, assumes the residual water in the item to be dried is lost to space. Cabin air loss is also computed, since the chamber contains a finite amount of cabin air prior to pump down.

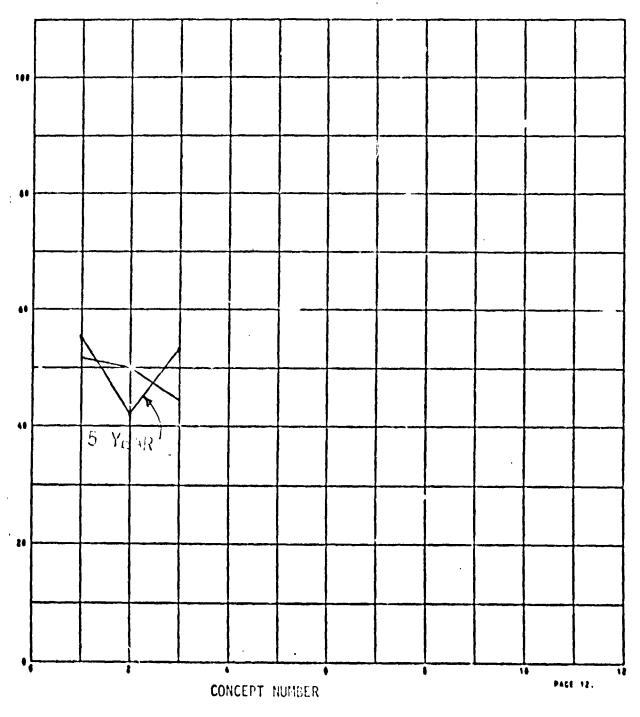
| | | : | , | ! | | | | | | | | ! | | i | |
|---------------------------------------|-------------------------------------|--|--|-----------|--|-----------------|-------------------------|---------------------------------|---------------------------------|--|---|--|--|---|---------|
| | 1 1 M E | W.nswoJ | 6.1.5 | 0 1 0 0 0 | N 12 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 5 - 2 - 3 - 3 | THE KM A. | ۲ ۲ ۲ | , rec P | TO SEE A PERSONAL SERVICES AND ADDRESS AND | - 10 A C F | ۷i ا ا | SEVELLPRENT COST | | ים ר |
| i | L 3/04 S/USE | J | 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | FL0. | PRESS -FTHG- | TEMP TOEG C- | 1 COLANT - 7 A 1 TS- | 11 LEAK 12 LEAK 18 LC HK) | A | AC 77 R | # E 1 C # 1 | | VAIL INCES | X 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | |
| | | | | | | | 37. | | | | 7.5.7 | 5.7 | · · | | |
| | 037 | | | | | | 1.25.1 | 1.266 | 0 | 3. | 105.61 | ~(J3•9 ~) | | 36 7 | 9 . 6 6 |
| · · · · · · · · · · · · · · · · · · · | 37 | | ! | 1 | 1 | ; ; ; | | 00.0 | 0.0 | 0.0 | 197-0 | . 30.301 | , | 296 1 | 179.5 |
| • | 00.000 | | | | - | , | 00.0 | . 261.1 | 1725.0 | 1725.0 | 7.3 | .62 | .s | _ | υÖ |
| 10 M C | C O N C REUSABLE D DISPOSABLE | N C E BLE DRY SAGLE D AIC. 'S | REUSABLE DRY WIPES DISPOSABLE DRY WIPES ELECTRIC (28 | w X | | Or Or | | | € | IN AIR | CIPCULATED) |), LITERS/ , 75,-2 , 17, 48 | 38. (F. (F. (F. (F. (F. (F. (F. (F. (F. (F | æ | |
| | | | ! | ; | : | IGINAL PC DP | | ; | | | CITC (ATED) LITE (ATED) CONTROL (ATED) PROCESSEE) | | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1) | | |
| | | | | | 1 | PAGE IS | | | | (**)A:AILABLE AVAILACLE | | (***) 103167103 103167103 103167103 | -031 -010108 -151 | 1 | |
| | i | | | | 1 ' | | | | (2) STATE (3) SOUE L (4) EXTENS | STATE OF THE ART SOUE LEVELOPHENT REQUIRED EXTENSIVE DEV. REQUIRED | REQUIRED QUIRED | 25- 50- 75- | 25-50% 50-75% 75-100% | ! | İ |

APPLIANCE CONCEPT

CONCEPT NAME

- REUSABLE DRY MIPES

2 - DISPOSABLE DRY AIPES
3 - ELECTRIC DRYER



Partial Body Drying (Space Station) Concept Trade

| #ATAIK * * * * * * * * * * * * * * * * * * * |
|--|
|--|

| * - | | THE PROPERTY OF THE PROPERTY O |
|---|--|--|
| | CONCEPT | |
| i | | OF |
| NORTAL 51.71 50.93 | 44.43 | igi |
| - | | NA 2001 |
| 35.85 | | R |
| 90°45 88°75 310°0A | | 19 |
| 81.12 A | 35°°C 7 | PA(UA |
| 53.18 | | |
| 97.74 | 40.04 2 0.04 | |
| | | 3 |
| | | |
| | The state of the s | • |
| | SENSITIVITY ANALYSIS | 2 |
| 1 | : | |
| SINGLE SELECTION | | |
| (E) | ON 100 S MAX PUINTS! | A |
| | | |
| 2 | | |
| NORMAL 51.71 50.00 | C**** | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - |
| #E1611 50.67 55.17 | 10.0 | |
| 46.72 | | |
| U. C. + 10 C. | | to a manufacture of the control of t |
| STORE SCOOL SERVED | 52 ° 1 × 52 | en enderstyden heinese he bester e e henre terri de mennet te der de ender het ender de ender de ender e |
| 91.05 | | |
| 0£+ CUST 57.04 55-17 | ŀ | |

1 (1.59

| | | SELECTION | MATRI | 102/05/75 | 751 | PARTIAL | BODY DRYING (SPACE STATION) | LIONI |
|---------------------------|---|--|---|-----------|------------------------|--|--------------------------------|-------|
| FACTOR | 108 | MIN | MAK | 219 | | ~ | CONCEPT | |
| #61647 #0464 VOLUTE | 1 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | 00000 00000 00000 | 1224.7 | 51 | 9.27 15.90 7.10 | 00. | 14.45 .03 9.83 | |
| 1 | THE SHAPE LELIAGE | | 0.0000000000000000000000000000000000000 | 51 | | 15.00 5.00 | 11.27 | |
| 7 0 2 1 | DEV COST REC COST TOTAL PT | 000000 | 5.0000 8.0000 8.5000 9.5.70 | | 5.73 11.22 52.59 | 8, 50 00 00 00 00 00 00 00 00 00 00 00 00 0 | .0.3 .0.3 .0.54 .0.54 | |
| * | 9 | 00000 | 100.50 | 100 | 55,35 | 42.11 | 53.20 | |
| ; ; | ! | | | | | | | |
| | | | | | | | | |
| , | | i | | | | | | |
| | | | | | | | | |
| \$ \$ 1 | • | The state of the s | | | ! | | | |

| SENSITIVITY AMALYSIS RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY 1 ASED ON 100 B MAX POINTS! C O N C E P T C O N C E P T SS.35 42.11 53.20 SS.44 49.31 SS.44 49.31 SS.50 43.57 44.81 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.50 43.57 51.84 SS.70 44.51 SS. | s os |
|---|-------|
| SENSITIVETY AMALYSIS RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY 1 | 8 OS |
| SINGLE SELECTION PARAMETER REIGHTING FACTOR BY 1 | s os |
| \$5.35 42.11 53.20 \$5.35 42.11 53.20 \$5.83 37.02 \$6.36 \$5.62 46.34 49.31 \$5.13 46.34 59.31 \$5.13 46.34 59.31 \$5.13 46.34 59.31 \$5.13 46.34 59.31 \$5.13 46.34 59.31 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 46.34 59.63 \$5.13 49.31 \$5.13 46.34 59.63 \$5.13 49.31 \$5.13 46.34 59.63 \$5.14 50.63 50.63 \$5.14 | |
| \$5.35 %2.11 \$3.20 \$5.83 37.02 \$6.36 \$8.62 46.34 49.31 \$6.13 46.34 55.46 \$1.30 40.35 51.64 \$6.50 43.57 51.64 \$1.30 37.02 47.31 \$6.50 43.57 51.64 \$1.50 37.02 56.63 \$6.70 30.02 56.63 \$6.70 30.02 56.63 \$10.66 ERECTION PARANETER REIGHTING FACTOR BY CONCEPT AFTER INCREASING \$10.66 SELECTION PARANETER AEIGHTING FACTOR BY CONCEPT AFTER INCREASING \$10.66 SELECTION PARANETER AEIGHTING FACTOR BY CONCEPT AFTER INCREASING \$10.66 SELECTION FOR STATE POINTS | |
| \$5.83 37.02 \$6.36 \$8.62 46.34 49.31 \$6.13 40.00 55.46 \$1.30 46.34 54.81 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.50 43.59 51.84 \$6.70 50 50 50 50 50 50 50 50 50 50 50 50 50 | |
| S6-13 40-00 55:46 51-30 46-34 54-81 56-50 43-59 51-84 56-50 43-59 51-84 56-50 43-59 51-84 56-50 43-59 51-84 56-50 43-59 51-84 56-50 43-59 51-84 51-30 46-34 56-50 43-59 51-84 51-30 46-34 56-50 43-59 51-84 51-30 46-34 56-50 43-59 51-84 56-50 43-50 51-84 56-50 43-50 | |
| \$4.50 43.57 51.84 \$4.50 43.57 51.84 \$4.50 43.57 51.84 \$1.30 37.02 49.31 \$4.78 37.02 50.43 \$4.78 37.02 50.43 \$1.40 FOR EACH CONCEPT AFTER INCREASING \$1.40 FOR EACH CONCEPT AFTER INCREASING \$1.40 FOR EACH CONCEPT AFTER INCREASING \$1.40 FOR EACH CONCEPT AFTER INCREASING \$1.40 FOR FACTOR BY \$1.4 | |
| S1.30 39.02 49.31 S4.78 39.02 S4.43 S4.78 39.02 S4.43 ENSIT, VITT ANALYSIS RATING FOR EACH CONCEPT AFTER INCREASING SINGLE SELECTION PARAMETER AEIGHTING FACTOR BY (BASED ON 300 & NAR POINTS) C O N C E P T | |
| SINGLE SELECTION PARAMETER ANTER INCREASING (BASED ON 100 & HAR POINTS) | |
| SINGLE SELECTION PARAMETER AFTER INCREASING SINGLE SELECTION PARAMETER AFTER INCREASING CASED ON 100 5 MAR POINTS! | i · |
| SINGLE SELECTION PARAMETER AFIER INCREASING SINGLE SELECTION PARAMETER AFIGHTING FACTOR BY (BASEO ON 100 B NAM POINTS) | |
| L U X O U | 8 05- |
| | |
| | |
| \$5.35 42.11 \$3.20 | |
| 45.71 | |
| | |
| 60 - 10 - 10 - 10 - 10 - 10 - 10 - 10 - | |
| MAINTENC 54-15 40-54 5 64 CEV COST 60-10 45-71 57-70 | |
| 53.44 45.71 | |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 2.2.3-PARTIAL BODY DRYING

| 1 | a. antaramé strate directorarios construcción co ac- | |
|---------|--|--|
| | NUMBER OF SAFETY CRITICAL ITEMS | 000 |
| | 0 | |
| | 0 | |
| | 0 | • |
| S | 0 | |
| 1- | 0 | |
| O N | 0 | |
| a. E | 0 | |
| O U | 0 | |
| 0 F | 0 | |
| | 0 | |
| BER | | |
| H U H | Э иелтея | 1 1 - |
| | CONTROLLER | 1 1 = |
| | © CGRIBOLLER | |
| | 80101 | 1 1 |
| | | |
| | | |
| | COMPONENT TYPE | ۶. |
| | | DICHOSABLE DRY WIPES DICHOSABLE DRY WIPES ELECTRIC DRIER |
| | APPLIANCE TYPE | REUSABLE DRY WIPES DICHOSABLE DRY WIPE ELECTRIC DRIER |
| / | ינואוני | 3 |
| | 4 | 쓅治교 |

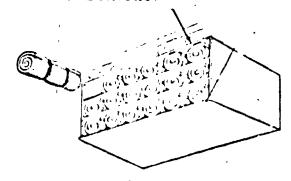
D2 1101 11 4

| SPACECRAIT Space Station | |
|--|---|
| HABIT. ILITY SUBSYSTEM Personal Hydiene HABITABILITY FUNCTION Body Cleansing | - |
| APPLIANCE FUNCTION Partial Body Drying | |
| APPLIANCE CONCEPT NO./TITLE 1/Reusable Dry Wipes | |
| INDEX NO. 2.2.3.1 REF. NO. 236.250 | - |

DESCRIPTION

The reusable dry wipe concept consists of wipes made of terrycloth. The terrycloth wipes are 15 x 30 inches and are used 10 times per day before washing. The concept includes the weight and volume of the wipe dispenser. The towels are washed and dried after one day of usage and are discarded after 60 washings. The concept is penalized for the washer/dryer function required to recycle the wipes. The corrycloth wipes are smaller and lighter than the terry towels used for whole body drying after showering.

TOWEL DISPENSER



D2-H856E4

APPLIANCE CONCEPT REQUIPEMENTS AND PENALTIES CALCULATIONS

INDEX NUMBER 2.2.3.1

| | 930_ | | • | A A | 7 | 97 4 |) | 3.32 |
|---------------|---------------------|--|---|--|--|--|--|--|
| (BTU/H | NT LEAK R/CYCLE) | TO C001 | ANT CYCLE) | | | WEIGHT (LB/MISSIO | N) (FT | VOLUME 3/MISSION |
| | | • | <u>P</u> <u>E</u> ! | NALII | <u>E S</u> | ••• | • | |
| | | • | | | | <u>.</u> . | | |
| | • | | | • | | , | | |
| | • | | | | | | | 4 . 4 |
| TOTAL | WATT (BTL | I/HR) | WATT (I | BTU/HR) | WA' | IT (BTU/HR) | | T (BTU/HR |
| | | • | | , | | | · · | |
| | ***** | | | | | | | |
| | | | | | | | · · | |
| | | • | | | | | | · · · · · · · · · · · · · · · · · · · |
| | (BTU/HI | ₹) | (BTU | /HR) | | (BTU/HR) | (| BTU/HR) |
| | | | | | | | | COOLANT |
| | IHERM | AL R | E Q U I R | <u>EMENI</u> | <u> </u> | | | • |
| | | | • | | | • | | • |
| • | | | | | | | | • |
| | MAXIM | * UM | • | TOTAL | | AX I MUM | | TOT |
| | | | · | • | | · · · · · · · · · · · · · · · · · · · | • | ******* |
| | | | | | | | | |
| | | | | ········· | | | | |
| | | | | | | | | , |
| | | | | , | | · · · · · · · · · · · · · · · · · · · | | |
| CYCLE (HR) | | | | CYCLE) | r. <i>)</i>) (| | AVERAGE (WATTS) | DEM CYCL ①X |
| | |) | 3 | | D | (5) | 6 | |
| _ | | м L . | PUNL | K | _ | D C | POWE | . K |
| | CYCLE (HR) TOTAL | THERM LATEN (BTU/HI OPERAT HEAT LEAK (BTU/HR/CYCLE) | USE TIME (2) CYCLE PEAK AV (HR) (WATTS) (W MAXIMUM I H E R M A L R LATENT (BTU/HR) O P E R A T 1 O N A L HEAT LEAK TO COOK (BTU/HR/CYCLE) (BTU/HR/CYCLE) | THERMAL REQUIR LATENT SENS (BTU/HR) WATT (BTU/HR) DEERATIONAL PEN HEAT LEAK TO COOLANT (BTU/HR/CYCLE) | THERMAL REQUIREMENT LATENT SENSIBLE (BTU/HR) (BTU/HR) DPERATIONAL PENALIL HEAT LEAK TO COOLANT (BTU/HR/CYCLE) (PK WATTS) | USE TIME (2) (3) DETAIND CYCLE PEAK AVERAGE (MATT-ME) (HR) (WATTS) (WATTS) (D) X(3) (MAXIMUM TOTAL M I HERMAL REQUIRFMENTS LATENT SENSIBLE (BTU/HR) (BTU/HR) TOTAL WATT (BTU/HR) WATT (BTU/HR) WATT OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) | USE TIME CYCLE PEAK AVERAGE CYCLE PEAK AVERAGE CYCLE PEAK AVERAGE CYCLE PEAK AVERAGE CYCLE PEAK AVERAGE CYCLE PEAK (HR) (MATTS) (MATTS) TOTAL MAXIMUM T | USE TIME ② ③ DEFAND ⑤ ⑥ CYCLE PEAK AVERAGE (MAT1-HP) PEAK AVERAGE (HR) (MATTS) (MATTS) (MATTS) (MATTS) MAXIMUM TOTAL MAXIMUM I H E R M A L R E Q U I R F M E N I S LATENT SENSIBLE HEAT LEAK TO (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT |

C.4

Q

· C2-270

36.7

(125) WATTS/CYCLE (BTU/HR/CYCLE) 23.5 (51.9) KG/MISSION (LB/MISSION) ./86 (6,58) M'/MISSION (FT //MISSION)

2**9** 2.5 (997.3) WATTS/CYCLE)

TOTAL

D2 1105/4-4

APPLIANCE CONCEPT PEQUIRENENTS AND PENALTIES CALCULATIONS (CONCEDED)

CONCEPT // REUSIBLE DRY WIPES

INDEX NUMBER 2.2.3.1

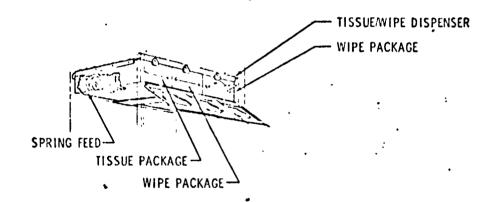
| DMPONENT | fner) | WEIGHT | QUIREMENIS | VOL UTIE |
|--|----------------------------|---|--------------------------------------|--|
| MONENT MSPGALS G72 | (REF) | (LBS) 1.765 | | (FI3) 455 |
| ULPES (KEUSAELL) | (234) | 1.63 | | .67 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | 2074 | 1 54 (0 | 2000 | |
| | TOTAL | | 395) | .063 (2.27) и ^з (гт ^з) |
| | | KG (LBS) | | nº (riº) |
| <u>\$ 0 L 1</u> | D EXPEND | | REQUIREMENT | <u>s</u> |
| | ① WT/L | ② ③ INIT (REF) WT/CYC IT/UNIT)(REF) ①x② | LE VOL/UNIT (RE | r) VOL/CYCLE (PEF) (DX 4) |
| | YCLE(REF) | (LB) (LB) | (FT ³) | (FT3) |
| EUSHBLE WIPES .OL | <u> </u> | 000 (256) .000 | | (2%) .0000668 |
| | | | | |
| | | | | |
| | ****** | | | |
| Britania and a supplication of the supplication and the supplication of the supplicati | | | | |
| | | ∑3 TOTAL WY | CYCLE | O TOTAL VOLVEYER |
| TAL WI. | ina | (LB) | | (FT3) |
| CYCLES/EAY | _ x <i>184</i> | | 8 1 | 741 (LB) (1.63) |
| TAI VOL | un d | (LB) | | |
| MISSION LYCLES/DAY | x <i>184</i> xbays/miss | 1011 X | 08. • L. | .019 (.67) |
| | • | (FT ³) | | |
| | <u>LIQUID</u> E | XPENDABLES B | LEQUIREMENIS | |
| | | Q TERESTEE 5 | _ | (|
| | AMT. USED/CYCLE (RE | F) RECOVERY | (3) AMT.RECOVEFED/CYCLE (ÛX(?) | AMT LOST/CYCLE (1) - (3) |
| TYPE WASH,EZZ WATETC | (LB) | FACTOR /0009 | · <u>10.0909</u> | (10) |
| OSS PENALTY | | | | |
| - | | | | |
| | | | | |
| | | | - | |
| ΣΟ | 10.1 | | Σ (| 00909 |
| | | • | | |

D2 412561 4

| SPACECRAFT | Space Station | |
|------------|---------------------|--|
| HABITABILI | TY SUBSYSTEM Person | al <u>Hygiene HABITABILITY FUNCTION Body Cleansing</u> |
| APPLIANCE | FUNCTION Partial | Body Drying |
| APPLIANCE | CONCEPT NO./TITLE | 2/Disposable Dry Wipes |
| INDEX NO | 2.2.3.2 | REF. NO236 |
| | | |

DESCRIPTION

The disposable dry wipe concept consists of wipes made of 4 ply "wet strength" paper. The paper wipes are 12 x 18 inches and are discarded after two uses. The wipe usage is based on 10 times per day per man. The wipes are disposed of by depositing into a vacuum drier to remove excess water. The dried wipe is then deposited into the refuse system. The concept includes the weight and volume of the wipe dispenser.



D2-1155C1-4

| • | | | | | | | |
|-------------------|----------|---------------------------|-----------------|------------------------------|--|---------------|----------------------------------|
| | | E L E C | | POWER | REQUIRE | | |
| COMPONENT A1/A | (REF) | USE TIME CYCLE (HR) | (WATTS) | G FOWE AVERAGE (WATTS) | (4) DEMA'ID (KATT-HP/ (YCLF) (1) X (3) | (WATTS) | (6) DE R AVEPAGE CYC (WATTS) (1) |
| | | | | | | | |
| • | | | | | | | |
| | | | | | | | |
| | | | | | - | | |
| ., | | | | | | | |
| | | | | | | | |
| | | | MAXIMUM | | TOTAL | MUNIXAM | 10 |
| • | | | • | | | | |
| | <u>/</u> | | (BTU/HR) | | /HR) | (BTU/HR) | (BTU/HR) |
| | | | • | · - | | | |
| | | | | | | | |
| | | | | | | | |
| | 701 | r A I | • | | • | | |
| | 101 | TAL | WATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT (BTU/ |
| | | | • | | | | • |
| | | | | • , | | | |
| • | | • | • | | | | , |
| • | | | <u>PERALLO</u> | NAL PE | <u>N A L I I E S</u> | | |
| • | | 7 | | | CICCTOTCAL | WEIGHT | |
| Sour | re | HEAT | THERMAL LEAK TO | D COOLANT | ELECTRICAL (PK WATTS/CYC | | ON) (FT)/MISSI |
| Sour | CE A | | LEAK T | D COOLANT U/HR/CYCLE) | (PK WATTS/CYC | | ON) (FT ³ /MISSI |
| SOUR | CE A | HEAT | LEAK T | D COOLANT U/HR/CYCLE) | | | ON) (FT ³ /MISSI |
| SOUR(| CE | HEAT | LEAK T | O COOLANT U/HR/CYCLE) | | | ON) (FT ³ /MISSI |
| SOUR! | CE A | HEAT | LEAK T | D COOLANT U/HR/CYCLE) | | | ON) (FT ³ /MISSI |
| SOURI | A | HEAT | LEAK T | D COOLANT U/HR/CYCLE) | | | ON) (FT ³ /MISS1 |
| SQURI | CE A | HEAT (BTU/HR | LEAK T | D COOLANT U/HR/CYCLE) | | | ON) (FT ³ /MISSI |

C2-273

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCEPTED)

CONCEPT 2/DISPISATELE PRY WIPES

INDEX NUMBER 2.2.3.2

2/2

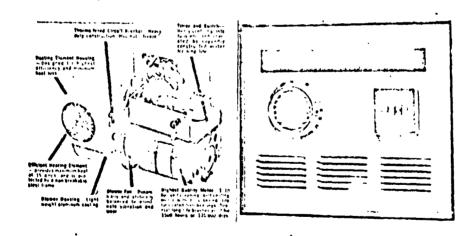
| DISPLANCE (236) 29.77 | 7.71 2.6 |
|--|-------------------------------------|
| TOTAL | |
| TOTAL TOTAL TOTAL TOTAL WITH STITE THE MENTS TOTAL WITH HISSITH ANTI-USED/CYCLE (REF) ANTI-RECOVERY ANTI-RECOVERY (R | |
| TYPE UNITS/CYCLE(REF) OTAL KT. OTAL KT. OTAL VOL HISSION CYCLES/DAY AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) (LB) CYCLES/DAY AMT. RECOVERY AMT. RECOVERY (LB) (LB) (LB | |
| TYPE UNITS/CYCLE(REF) OTAL KT. OTAL KT. OTAL VOL HISSION CYCLES/DAY AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) (LB) CYCLES/DAY AMT. RECOVERY AMT. RECOVERY (LB) (LB) (LB | |
| TYPE UNITS/CYCLE(REF) OTAL KT. OTAL KT. OTAL VOL HISSION CYCLES/DAY AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) (LB) CYCLES/DAY AMT. RECOVERY AMT. RECOVERY (LB) (LB) (LB | |
| KG (LBS) KD X/VICTE KD X/VICTE KD XD X X X X X X X X X X X X X X X X X | |
| KG (LBS) KD X/VICTE KD X/VICTE KD XD X X X X X X X X X X X X X X X X X | |
| TYPE UNITS/CYCLE(REF) OTAL KT. OTAL KT. OTAL VOL HISSION CYCLES/DAY AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) AMT. USED/CYCLE(REF) (LB) CYCLES/DAY AMT. RECOVERY AMT. RECOVERY (LB) (LB) (LB | |
| KG (LBS) KD X/VICTE KD X/VICTE KD XD X X X X X X X X X X X X X X X X X | |
| SOLID EXPENDABLE MITYOL REQUIREMENTS MITOMIT (REF) OMNT/UNIT (REM) OMNT/UNIT (REM) OMNT/UNIT (REM) OMNT/UNIT (REM) OMNT/UNIT (REM) OMNT | (0, 0) |
| SOLID EXPENDABLE MY/VOL REQUIREMENTS TYPE UNITS/CYCLE(REF) (PKG.WT/UNIT)(REF) OISPOSOBLE WIPE S. (234) | * ~ |
| TYPE UNITS/CYCLE (REF) (PKG. NT/UNIT) (REF) (LB) (NT/ONIT) (REF) (LB) (NT/ONIT) (REF) (LB) (NT/ONIT) (REF) (NT |) (FT3) . |
| TYPE UNITS/CYCLE (REF) (PKG. NT/UNIT) (REF) (LLL) (PKG. VOL/UNIT) (REF) (LLLL) (LLLL) (PKG. VOL/UNIT) (REF) (LLLLL) (LLLL) (PKG. VOL/UNIT) (REF) (LLLLL) (LLLLL) (PKG. VOL/UNIT) (REF) (LLLLLL) (PKG. VOL/UNIT) (REF) (LLLLLL) (PKG. VOL/UNIT) (REF) (PKG. VOL/UNIT) (RE | • |
| TYPE UNITS/CYCLE (REF) (PKG. NT/UNIT) (REF) (D) (PKG. VOI /UNIT) (REF) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (FT) (LB) (LB) (FT) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB | ⑤ |
| DISPOSABLE WIPS .5 (234) .022.83 (234) .01142 .002.283 (234) DIAL KT | VOL/CÝCLE ①x (4) |
| OTAL KT. OTAL KT. OTAL KT. OTAL KT. CYCLES/DAY DAYS/MISSION CYCLES/DAY DAYS/MISSION OTAL VOL MISSION CYCLES/DAY DAYS/MISSION CYCLES/DAY DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL VOL (LB) OTAL WITCH (LB) OTAL VOL (LB) O | (11) |
| OTAL KT. MISSION GOOD X 184 X 0142 S7.2 CYCLES/DAY DAYS/MISSION TOT.WI/LYCLE (LB) OTAL VOL MISSION CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 AMT. USED/CYCLE (REF) RECOVERY AMT. RECOVERTY (LB) TYP. (LB) FACTOR (LB) TYP. (LB) FACTOR (LB) TOTAL WILL AMT. WILL AMT. DAYS/MISSION X 001/42 S7.2 AMT. USED/CYCLE (REF) RECOVERY (LB) TYP. (LB) FACTOR (LB) TOTAL WILL AMT. WILL AMT. WILL AMT. RECOVERTY (LB) TO VACUUM DRYING | .001142 |
| OTAL KT. MISSION GOOD X 184 X 0142 S7.2 CYCLES/DAY DAYS/MISSION TOT.WI/LYCLE (LB) OTAL VOL MISSION CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 CYCLES/DAY DAYS/MISSION X 001/42 S7.2 AMT. USED/CYCLE (REF) RECOVERY AMT. RECOVERTY (LB) TYP. (LB) FACTOR (LB) TYP. (LB) FACTOR (LB) TOTAL WILL AMT. WILL AMT. DAYS/MISSION X 001/42 S7.2 AMT. USED/CYCLE (REF) RECOVERY (LB) TYP. (LB) FACTOR (LB) TOTAL WILL AMT. WILL AMT. WILL AMT. RECOVERTY (LB) TO VACUUM DRYING | |
| OTAL WT. OTAL WOL MISSION CYCLES/DAY DAYS/MISSION TOTAL VOL MISSION CYCLES/DAY DAYS/MISSION TOT.VOL/CYCLE (LB) CYCLES/DAY DAYS/MISSION TOT.VOL/CYCLE (FT3) CYCLES/DAY DAYS/MISSION TOT.VOL/CYCLE (FT3) AMT.USED/CYCLE(REF) TYP. (LB) TAL WOL (LB) AMT.USED/CYCLE(REF) FACTOR (LB) TOTAL WILL TOTAL | |
| OTAL KT. MISSION CYCLES/DAY DAYS/MISSION OTAL VOL MISSION CYCLES/DAY DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION TOT. VOL/CYCLE (FT3) AMT. USED/CYCLE (REF) TYP. (LB) FACTOR (LB) TAMT. USED/CYCLE (REF) FACTOR (LB) TAMT. USED/CYCLE (REF) TYP. (LB) TOTAL WILL | |
| OTAL KT. MISSION CYCLES/DAY DAYS/MISSION OTAL VOL MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION TOT.VOL/CYCLE (FT3) AMT.USED/CYCLE (REF) TYP: (LB) FACTOR (LB) MATERIA LOSS DUE 0245 (236) MATALUSCUMM DRYING | |
| TOTAL WT. MISSION GOOD X 184 X 0142 ST.Z CYCLES/DAY DAYS/MISSION TOT.WT/CYCLE MISSION GOOD X 184 X 00142 KG CYCLES/DAY DAYS/MISSION X 101.WT/CYCLE MISSION GOOD X 184 X 001142 KG CYCLES/DAY DAYS/MISSION X 101.WOL/CYCLE (FT3) GAS/LIQUID EXPLNDABLES REQUIREMENTS MT.USED/CYCLE(REF) RECOVERY AMT.RECOVERID/CYCLE TYP: (LB) FACTOR (LB) MATER LOSS DUE 0245 (236) N/A N/A | |
| OTAL KT. GO X 184 X 0/142 57.2 OTAL VOL CYCLES/DAY DAYS/MISSION X TOT.WI/LYCLE (LB) OTAL VOL MISSION X 184 X 00/142 KG OTAL VOL (LB) OTAL | .001142 |
| OTAL KT. MISSION CYCLES/DAY DAYS/MISSION OTAL VOL MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION CYCLES/DAY DAYS/MISSION DAYS/MISSION TOT.VOL/CYCLE (FT3) CYCLES/DAY DAYS/MISSION TOT.VOL/CYCLE (FT3) AMT.USED/CYCLE(REF) TYP. (LB) FACTOR (LB) TAMTER LOSS DUE 0245 (236) MAA TO NACUUM DRYING | .001/42 TOTAL VOL/CYCLE (FT3) |
| OTAL VOL MISSION CYCLES/DAY DAYS/MISSION CYCLES/DAY DAYS/MISSION TOT. VOL/CYCLE (FT3) CYCLES/DAY DAYS/MISSION TOT. VOL/CYCLE (FT3) AMT. RECOVERY TYP: (LB) FACTOR (LB) TACTOR (LB) TO VACUUM DRYING | |
| OTAL VOL MISSION BOX A 184 X 00/142 BASSION X 184 X 00/142 BASSION X 185510N X 10T.VOL./CYCLE (FT3) GAS/LIQUID EXPINDABLES REQUIREMENTS O | (LE) |
| CYCLES/DAY DAYS/MISSION X OO/42 CYCLES/DAYS/MISSION X OO/42 CYCLES/DAYS/DAYS/MISSION X OO/42 CYCLES/DAYS/DAYS/DAYS/DAYS/DAYS/DAYS/DAYS/DAY | |
| (FT3) GAS/LIQUID EXPLNDABLES REQUIREMENTS O O O O O O O O O O O O O O O O O O O | 7 (12.6) |
| TYP. WATER LOSS DUE .0245 (236) TO VACUUM DRYING | (F13) |
| TYP: (LB) FACTOR (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) (LB) | • |
| TYP. WATER LOSS DUE .0245 (236) TO VACUUM DRYING | |
| AMT. USED/CYCLE (REF) TYP: (LB) WATER LOSS DUE O245 (236) NA NA NA NA NA NA NA NA NA N | Φ |
| WATER LOSS DUE OZAS (Z36) NA NA OZAS (Z36) | ANT LOST CYCLE |
| WATER LOSS DUE . O245 (236) NA NA N/A | (LB) |
| CABIN AIR COSS 0007Z (234) N/A N/A | .0245 |
| CABIN BIR (955 _ 00012 (23-) N/A _ N/A _ N/A _ | |
| | -00072 |
| | |
| | |
| Σ①02522 Σ Ω | |
| 20 _ 102022 | 02522 |
| OTAL WT | .02522 |

D2 1/85/1-4

| SPACECRAFT Space Station | |
|------------------------------|--|
| HABITABILITY SUBSYSTEM Perso | nal Hygiene HABITABILITY FUNCTION Body Cleansing |
| APPLIANCE FUNCTION Partial | Body Drying |
| APPLIANCE CONCEPT NO./TITLE | 3/Electric Dryer |
| INDEX NO. 2.2.3.3 | REF. NO. Electric-Air Corp. |
| | • |

DESCRIPTION

The electric dryer concept is identical to the terrestrial type used in restrooms. The concept incorporates a fan for blowing warm-dry air on the local body areas requiring drying. A nozzle is provided which can be used to direct the air stream. The concept does not require wipes for drying. A large "button" switch is provided for ease of actuation and the unit uses a timer to automatically turn off the unit after 40 seconds of operation. The automatic shutdown is incorporated to save power.



D251185C1-4

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS ONCEPT 3 / FLECTION DISCHARGE

INDEX NUMBER 2.2.3.3

| CONCEPT STELECTETE | DIETER | | | | INULX | NUMBER 2.2.3.3 |
|---|----------|--------------------------|-----------------------|---------------------|---------------------------------------|--|
| | ETEC | IRICAL ! | POWER | R F C U I R | EMENTS | |
| | | A (| . POWE | R | D_C | POWER |
| | USE TIME | ② . PEAK | (3) AVERACE | DEMAND (WATT-HR/ | (5) PEAK | (6) DEMAND AVERAGE (WATT-HR |
| COMPONENT (REF) | (HR) | (WATTS) | (WATTS) | (1) x (3) | (WATTS) | AVERAGE (WATT-HR CYCLE) (WATTS) ①X① |
| HEDITER / MOTOR (CUC | (R)_011_ | | 1775 | 18.9 | | |
| VIII 6 | | | | | • | |
| CONTRACTOR OF THE PROPERTY OF | | - | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | ` | | |
| | • | 1725. | | 18.9 | | |
| | | MAXIMUM | ٠, | TOTAL | MAXIMUM | . TOTAL |
| ٠. | | | | | , | |
| | • | • | | | | • |
| | | | • | | | • |
| | | <i>:</i> | • | | | |
| | | I H E R M A L | REQUI | REMENTS | • | • |
| • | | LATENT | SEN! | SI BL E | HEAT LEAK | TO COOLANT |
| SOURCE | | (BTU/HR) | | J/HR) | (BTU/HR) | (BTU/HR) |
| " | | | 2 | 61 | 261 | |
| LIENTER/MOTORS | | | | <u> </u> | | - |
| | | | | | | , |
| | | | 4 | | | desir Company de la company de |
| | | | | | · | |
| | | | | - , 1 | ************ | |
| | | • | 76.9 | (261) | 76.5861 | } |
| 1 | OTAL | WATT (BTU/HR) | | BTU/HR) | WATT (BTU/HR) | |
| | | wall (Bloylin) | mnii (| BIU/NKJ | MAII (BIU/NK) | WATT (BTU/HR) |
| • | | • | | | | |
| • | | | | | | • |
| | | | | | | |
| * • | | | | | | |
| | ! | <u>O P E R A I 1 O H</u> | IAL PE | MALTIE | <u>s</u> | |
| ••• | | THERMAL | | ELECTRICAL | L WEIGHT | VOLUME |
| , Source | HEA' | | COOLANT /HR/CYCLE) | (PK WATTS/C | | |
| | \ | | | , , | • | |
| -N/A - | <u>.</u> | | · · | | | |
| | | | | - | | |
| , | | | | ***** | | |
| · · · · · · · · · · · · · · · · · · · | | | | | | |
| , | | • | | | | , |
| | | | | | · · · · · · · · · · · · · · · · · · · | |

WATTS/CYCLE (BTU/HR/CYCLE) (E

TOTAL

WATTS/CYCLE (BTU/HR/CYCLE) KG/HISSION) (LB/MISSION) M³/MISSION (FT³/MISSION)

D2 115501 4

APPLIANCE CONCEPT PEQUIPMENTS PAD PENALTIES CALCULATIONS (CONCLUMED)

CONCEPT. 3/CLUCTRIC DRYGRZ

INDEX NOBLER 2.2.3.3.

| FIXED | MEIGHIVE | in Wit Bid | UIPEMENTS | |
|---|----------------------------------|-------------------------------------|------------------------------------|-------------------------|
| COMPOSENT (REF) EUECNICIO DRYER ASSY (COLO | | KEIGHT (LBS) | | VOLUME (+1') -53 |
| TOTAL | | 7.26 (/c | (c) (c) | DIS (.53) |
| SOLID EX TYPE UNITS/CYCLE (REF) | PENDABLE (PKG.WT/UNIT)(F) (LB) |) M T/(Y() F | VOL/UNIT (PEF) (PKG. VOL /UNIT) (P | VOL/CTCLE (F13) |
| TOTAL WT | X AVS/MISSION | 101AL WT/CY (LB) TOT.WT/CYCLE (LB) | Σ. | S TOTAL VOLTCYTE (FT3) |
| TOTAL VOL WISSIUM CYCLES/DAY G A S/L 1 Q U 1 | AYS/MISSION) | TOT. VOLVEYELE (FT3) | QUIREMENIS | , M2_(11 ₂) |
| AMT.USED/ | CYCLE(REF) | RECOVERY FACTOR | AMT. RECOVERED/CYCLE (LB) | AMT LOST/CYFLE (LB) |
| TOTAL MT. MISSION CYCLE/DAY ** LAYS/MS | SSTEET X YOTAL'T | csy/cycle | ΣΦ. | kg (i b) |

| HABITABILITY SUBSYSTEM 2.0 Personal Hydiene |
|---|
| MABITABILITY FUNCTION 2.3 Personal Grooming |
| APPLIANCE FUNCTION 2.3.1 Shaving |
| NUMBER OF CONCEPTS CONSIDERED 5 |

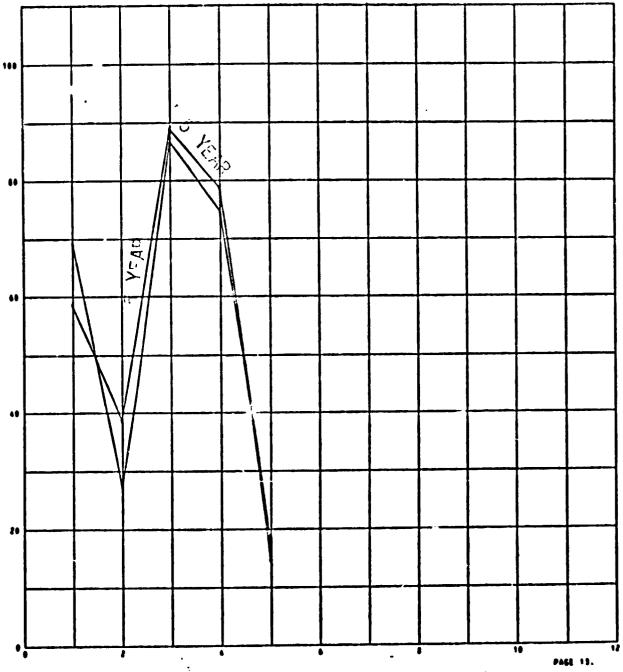
ASSUMPTIONS

- (1) The shaving concepts are mechanical, electric, and vacuum operated with methods incorporated to retrieve cut hair particles to prevent cabin contamination.
- (2) The study assumed one shave per day per man.
- (3) Shaving is assumed to take 6 minutes per shave (236).

| INDEX 40. 2.3.1 | , | 971AFR | G ISPACE | STATIONS | | | | | | | | | | | |
|-----------------|-----|--------------------------------------|---|---------------|---|--|-----------------------------------|---|---|--|---------------------------------------|---|----------------------|------|-----------|
| 5 | | CONSUMBLES AND | | FOULHEMEN | THERMAL RECUTS | 03# 1 | ¥ 1 S | ELEC PAR | R REDMTS | #T/VOL | . #EGHTS | | DF YELOPHEWT COST | £ 22 | *JAGUS 34 |
| 960768W | | A41. USED -KG/JSE- (LB/USE) | R 0 7 | 1 | CODLAND | 1 40 R • 1 H | | | | # # # # # # # # # # # # # # # # # # # | # # # # # # # # # # # # # # # # # # # | | | | |
| 000. | | | | | • | ~ | | ••• | • • | 13.2 | - | | 0 | • | 8.4 |
| 601. | | ; | | : | • • • • | - | 12. | 30.0 | 0.00 | 3:1 | - | 1 (29 | 2 | - | ត្ |
| .103 | | | | ; | • | - | ••• | ••• | ••• | 9:01 | ·· | 1 62 1 | 0 | - | 0.0 |
| .103 | | | | | :: | - | :: | ••• | 00 | ∾: | 5.0 | - 60 | 2 | - | 0.0 |
| 001. | | | 1 | , | | - | 12. | 30.0 | 0.00 | 23:42 | _ | 1 100 | 2 | Ţ. | 21.13 |
| | | • | | | | | | | | | | | | | |
| LABRET LABOR | | - - | w 8 | | | 3 | | :: A A B B B B B B B B B B B B B B B B B B | (TROULATE (LOST) | | 3/SEC | (FT ³ /*!N) (LE/+9) | | | |
| | . 1 | | ETV P420R AND #420R/44CUM 420R #1VEN #420R #20R/44CUM | TO CREA | | | | CAYERN COOLTIG WATER NITTER NITTER NITTECT FFECY KATER | (LOST) (C190LATED); (D180T) (C1ROULATED); (C1ROULATED); (PROCESSED); | (6) K6/47 (6) K6 | | (LE/-2) (LE/-2) (LE/-2) (LE/-2) (LE/-2) | | | |
| | ! ! | | | P 10 | ORIGI | | | | | į. | 1803(***) | | | | |
| : | : | • | | OR | N A1 | ت | (1) AVAILAGLE | AVAILASLE | | | 0-25% | - 1 | | | |
| | | ' ' | ; ; | U PAG QUAL | Pi ma | | (2) STATE (3) SGYZ DI (4) EXTENS: | STATE OF THE ART SOWE DEVELOPMENT REQUIRED EXTENSIVE DEV. REQUIRED | r r required required | | 25-50% 50-75% 75-100% | | | | |
| | | | i | | , | 1 | | I | • | | ; ; | | | | |

APPLIANCE
CONCEPT
NO. CONCEPT NAME

1 - FET SHAVE WITH SAFETY RAZOR AND CREAM
2 - DRY SHAVE-ELECTHIC RAZOR/VACUUM COLLECTION:
3 - DRY SHAVE-WINDUP RAZOR
4 - CRY SHAVE-VACUUM DRIVEN RAZOR
5 - RET SHAVE-SAFETY RAZOR/VACUUM



CONSTPT NUMBER

Shaving (Space Station) Concept Trace

| į | • | SELECTION BITLING 182/04/74) | | (112/00/74) | • ? | • • • • • • • • • • • • • • • • • • • | | | | , |
|-----|-----------|------------------------------|-----------|-------------|--------|---------------------------------------|-----------------------------|-------|-------|---|
| 1 : | FACTOR | Min VALUE | PAE VALUE | 27 | · •- | | • | | F 10 | • |
|) | RE16HT | . 37000 | 20.00 | 5 | . 5 | 19.11 | 14.50 | 14.81 | 00. | • |
| | 8 W # O 1 | | 507.41 | 2 5 | 91. | | | 96. | 000 | |
| | 425015 | 0.0000 | 5.2480 | 2 - | 15.00 | 00. | | 15.00 | .37 | |
| , | REL146-V | | 1.0000 | S | 5.03 | 000 | .03 | 00. | 5.00 | |
| | RAINTENC | 8.0000 | 000001 | ب د م | 00.00 | | | | | i |
| | TOTAL PT | 00000 | 000.00 | | \$5.56 | 21.69 | 69.32 | 54.78 | 13.95 | |
| | RATING | •30000 | 100.00 | 100 | \$4.45 | 27.12 | 100 67.45 27.12 86.65 74.72 | 74.72 | 17.43 | 1 |

3173411

O

•

| OR | IGI | NAL | PA | æ | B |
|----|-----|-----|-----|---|---|
| of | PC | OR | QUA | L | Y |

| | SELECTION | SELECTION PATRIX | (1,2/09/24) | | | C STAC | SHAVING (STACE STATION) | 2 ; |
|----------|--------------|------------------|-------------|---------|---------|---------|---|------------------|
| FACTOR | MIN VALUE | HAX | 214 | | ~ | • | | ' m • n •- |
| #EIGHT | .37000 | 29.900 | 51 | | 11.61 | 14.50 | 14.81 | .00 |
| PONTR | • 00000 | 89.265 | 5 | 15.00 | 00. | 15.00 | 15.00 | 3.58 |
| JHDTGA. | -45010-02 | ŀ | . 01 | •16 | 5.08 | 9.87 | 9.96 | 00. |
| THERMAL | • 00000 | 5.2480 | 15 | 15.00 | 000 | 15.00 | 15.00 | .37 |
| RELIAB-Y | 28544. | 1.0000 | . 5 | 5.00 | .00 | 00. | • 00 | S.00 |
| MAINTENC | 1.00000 | 1.00.00 | 'n | 5.00 | • 00 | • 00 | | 5.00 |
| DEV COST | .00000 | 15.000 | 15 | 15.00 | 2.00 | 15.00 | 2.00 | • 00 |
| REC COST | .00000 | 21.600 | 51 | 00 | | 15.00 | | .00 |
| TOTAL PT | -00000- | 000-56 | - 65 | 95*55 . | . 36.69 | -84.32- | - 74.78 | 13.95 |
| - RATING | 00000 | 100.00 | • | - 58,48 | 38.62 | .66.76 | -100 58,48 - 38,62 -68,76 - 78,71 - 14,48 | .14.68 |

6173419

| ANALYSIS CEPT AFTER INCREASING R PEIGHTING FACTOR BY SO 8 HAX POINTS! N C E P T S 71 14.68 18 13.60 27 13.78 70 16.87 70 16.87 70 16.87 70 16.87 70 16.87 70 16.87 70 16.87 71 19.60 27 13.60 | ORIGINALI PAGE IS OF POOR QUALITY | |
|---|---|---|
| SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY SO S (BASED ON 10C S HAX POINTS) C O N C E P T C O N C E P T C O N C E P T S4.40 41.44 87.34 8C.18 13.60 61.52 35.80 87.25 80.27 13.78 61.52 35.80 87.58 80.27 13.78 59.55 37.43 86.48 74.70 16.87 61.52 38.23 86.48 74.70 16.87 61.52 38.24 87.58 80.27 13.60 54.20 43.12 87.58 80.27 13.60 | ORIGINAL PAGE IN | |
| 50.40 41.46 89.34 80.71 14.68 54.40 41.46 89.34 80.17 15.35 41.52 35.80 49.58 80.27 15.35 61.52 35.80 89.58 80.27 13.95 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 | ORIGINAL PAGE I | |
| 54.40 41.46 69.34 6C.18 13.60 41.52 35.80 87.53 6C.27 15.35 55.44 39.23 89.23 79.76 13.95 41.52 35.80 87.58 6C.27 13.78 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 61.52 38.24 89.58 75.39 13.60 54.20 83.12 87.58 80.27 13.60 | ORIGINAL PAGE IS | |
| 54.40 41.46 69.34 86.18 13.60 41.52 35.80 69.58 86.27 15.35 55.64 39.23 79.76 13.95 41.52 35.80 69.58 86.27 13.95 59.55 37.63 86.48 76.70 16.87 59.55 37.63 86.48 76.70 16.87 61.52 38.24 89.58 75.39 13.60 54.20 43.12 89.58 80.27 13.60 | ORIGINAL PAGE IS | 1 |
| 59.55 37.63 86.48 74.70 16.87 59.55 37.65 86.48 76.70 16.87 61.52 38.24 89.56 75.39 13.60 54.20 *3.12 89.58 80.27 13.60 | NAU PAGE I | |
| S4.20 4)-12 89-58 80-27 13-60 | PAGE I | |
| | | _ |
| SENSITIVITY ANALYSIS | | , <u>, , , , , , , , , , , , , , , , , , </u> |
| SINGLE SELECTION PARAMETER WEIGHTING FACTOR BY -50 S (BASED ON 100 S MAX POINTS) | | 3561-4 |
| CONCEPT | | |
| MORHAL 58.48 35.62 88.76 78.71 14.68 | | 1 |
| 54.93 41.93 87.79 76.89 13 | | 1 |
| 11 - 60 - 60 - 71 - 71 - 71 - 71 - 71 - 71 - 71 - 7 | - Annualist . Approximation (and an include a second of a second of | ! |
| 91.16 - 87.79 - 87.79 | | |
| | | |

C2-284

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

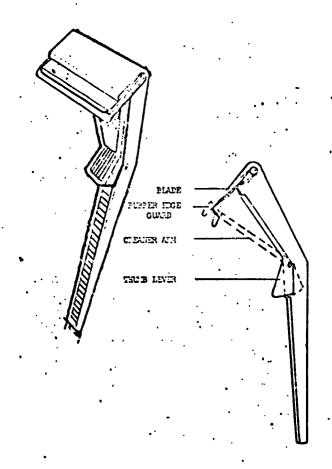
APPLIANCE FUNCTION: 2.3.1-SHAVING

SAFETY NUMBER CRITICAL ITEMS P COMPONENTS 0 ш X B D Z яотом<u>С</u> COMPONENT TYPE DRY SHAVE-ELECTRIC RAZOR/VACUUM COLLECTION DRY SHAVE-VACUUM MOTOR-DRIVEN RAZOR WET SHAVE-SAFETY RAZOR/VACUUM WET SHAVE WITH SAFETY RAZOR AND CREAM DRY SHAVE-WINDUP RAZOR APPLIANCE TYPE

| SPACECRAFT Space Station | |
|---------------------------------|--|
| HABITABILITY SUBSYSTEM Personal | Hygiene HABITABILITY FUNCTIONPersonal Grooming |
| APPLIANCE FUNCTION Shaving | · · |
| APPLIANCE CONCEPT NO./TITLE | 1/Wet Shave-Safety Razor and Cream |
| INDEX NO. 2.3.1.1 | REF. NO. <u>236,207</u> |
| • | · |

DESCRIPTION

The safety razor and cream wet shaving concept consists of a safety razor and cream. The safety razor is an injector type and the shaving cream is contained in aerosol cans. The Skylab crew felt shaving cream should be dispensed using an aerosol can. The safety razor is provided with an arm which is actuated to remove the hair particles and cream prior to wiping the razor. One new blade is provided for every three days of usage. This concept was flown on Apollo.



| | | ĒĔĒĞ | | POWER | REQUIR | | 6 A 11 E | 0 |
|------------|--|---------------------------|---------------------|---------------------------------------|---|-----------------------|-----------------------|----------------------------------|
| COMPONENT | (REF) | USE TIME CYCLE (HR) | PEAK (WATTS) | O POWE AVERAGE (WATTS) | DETIAND (WAIT-HR/ CYCLE) (DX(3) | (5) PEAK (WATTS) | FOHE AVERAGE (WATTS) | DENV (WATT- CYCLE (1) X |
| | | | | | | | | |
| | | | | | | • | | |
| | | | | | | | | |
| | | | | | | | | |
| | 1 | | MAXIMM | | TOTAL | MAXIMUM | | 101 |
| | | | | | | | | |
| | | | IHERMAL | . <u>R E Q U I </u> | REMENIS | | | |
| SOU | RCE | | LATENT (BTU/HR) | | SIBLE U/HR) | HEAT LEAK (BTU/HR) | | COOLANT TU/HR) |
| <i>N</i> . | 11 | | | · · · · · · · · · · · · · · · · · · · | | | | · |
| | | | • | | | , | | · |
| | | | | | | | | |
| | t general and the general distributions and the second | | | | | | | |
| | | TOTAL | WATT (BTU/HR) | WATT (| (BTU/HR) | WATT (BTU/HR) | - WATT | (BTU/HI |
| | | | | | | | | • |
| | • | | | • | • | | | |
| | | | | | | _ | | • |
| | | | OPERATIO THERMAL | NAL PE | MALTIES | | | |
| SO | URCE | HE/ (BTU/H | NT LEAK T | O COOLANT U/HR/CYCLE) | ELECTRICAL (PK WATTS/C) | | | OLUME /MISSIO |
| N | / <u>A</u> | | | | | • | | |
| | | | | | | | | |
| | | | | | · • • • • • • • • • • • • • • • • • • • | | | |
| | | | | | | | | |
| | | | | | *** | | - | |

APPLIANCE CONCLPT REQUIPEMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

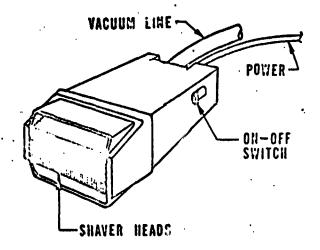
CONCEPT ## CONCEP

| OMPONENT | ·(REF) | WEIGHT (LBS) | | VOLUME (FT³) |
|---------------------------|-------------------------------|--|--------------------------------|---------------------------------------|
| RACOK/HOLDER BLADES | | <u>7.51</u> 21.6 | <u> </u> | .656 |
| | | 41.6 | | |
| | | | | |
| <u> </u> | | | | |
| | | | | |
| | | | | |
| | TOTAL | 13.2 (2 KG (LBS) | 9.11) | 035 (1.240 N3 (FT3) |
| `. <u>\$</u> <u></u> | <u>OLID EXPE</u> | NDABLE WIVOL | REQUIREMENTS | <u>s</u> |
| | O (P | Ø . Ø MT/UNIT (REF) WT/CY KG.WT/UNIT)(REF) ①X | () | F) VOL/CYCLE |
| | NITS/CYCLE(REF) .333 (236) | KG.WT/UNIT)(REF) ①X((LB). (LE -0587 (232) -019: | (FRE. VOL. 70117) 57 .00158 | (£13) |
| BLADES | روی دده | | | 7(3),000321 |
| | | | | • |
| | | | | |
| | | | | |
| | | ∑③ _ <i>0/9</i> TOTAL WI (LE | /LTCLE | (FT) |
| OTAL WT. 6 | x 18 | | | 9.3 (21.6) |
| MISSION CYCLES/ | DAYS/I | 84 x 0/94 MISSION X 101.WI/CYC (LB) | l.E | KG (LB) |
| OTAL VOL MISSION CYCLES/ | x x | 4 x000 | 529 | |
| CICLES/I | DATS/ | 115510N 101.VOL/CV (FT ³) | CLE | H ₃ (FT1) |
| | <u> </u> | <u>EXPENDABLES</u> | REQUIREMENTS | • |
| • | 0 | ② | AMT.RECOVERED/CYCLE | AMT LOST/CYCLE |
| TYPE | AMT.USED/CYCLE | (REF) RECOVERY FACTOR | Ox (i.e) | 0-0 |
| -N/A - | • | | | _ |
| | | | | |
| | | | | |
| | | | ΣΘ | |
| | | • | 26 | · · · · · · · · · · · · · · · · · · · |
| DTAL NT. NISSTON | | | | |

| SPACECRAFT Space Sta | tion |
|------------------------|---|
| HABITABILITY SUBSYSTEM | Personal Hygiene HABITABILITY FUNCTION Personal Groomin |
| APPLIANCE FUNCTION | Shaving |
| APPLIANCE CONCEPT NO./ | TITLE 2/Dry Shave-Electric Razor/Vacuum Collection |
| INDEX NO. 2.3.1. | 2 REF. NO. 236,207 |

DESCRIPTION

The electric razor/vacuum collection dry shave concept consists of an electric razor with vacuum collection of the cut hair particles. The electric razor incorporates a hood to aid vacuum collection. The unit requires a vacuum for collection of the hair particles. The concept, therefore, is penalized for a vacuum unit based on operating time. The vacuum unit used is identical to the Skylab power module.



APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS

INDEX NUMBER 2.3.1.2

CONCLPT 2/DRY SHAVE-ELECTRIC KNOOR /VACUUM COLLECTION ELECTRICAL POWER REQUIREMENTS POWER POWER DEMAND (7) DEMAND USE TIME 0 3 (3) **6** (WATT-HR/ (WATT-HR/ CYCLE PEAK AVERAGE PEAK AVERAGE CYCLE) CYCLE) (HR) COMPONENT (REF) (WATTS) (WATTS) (WATTS) (WATTS) 3.0 RAZOR MOTOR (236) 30 30 3.0 MAXIMUM TOTAL MUMIXAM TOTAL THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COOLANT (BTU/HR) (BTU/HR) (BTU/HR) SOURCE (BTU/HR) RAZOR MOTOR 12 (41) 12 (41) TOTAL WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) <u>OPERATIONAL</u> PENALTIES THERMAL TO COOLANT (BTU/HR/CYCLE) ELECTRICAL ME IGHT VOLUME HEAT LEAK SOURCE. (PK WATTS/CYCLE) (LB/MISSION) (FT3/MISSION) (BTU/HR/CYCLE) VACUUM POWER MODULE (SKYLAB) .34 .00057 11.7

WATTS/CYCLE

(BTU/HR/CYCLE)

115 (00)

KG/HISSION

(LB/HISSION)

(COZ) M³/MISSION (FT³/MISSION)

WATTS/CYCLE

(BTU/HK/CYCLE)

TOTAL

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

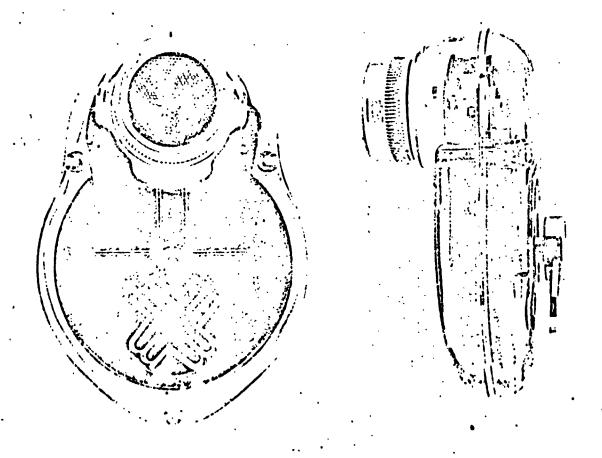
CONCEPT 2 DRY SHAVE - ELECTRIC KAROK/VAKOUM COLLECTION INDEX NUMBER 2.3.1.2

5|5

| TOTAL Z.7 (6.0) KG (LBS) N3 (FT3) SOLID EXPENDABLE MI/YOL REQUIREMENTS MT/UNIT (REF) (PKG.WIT/UNIT)(REF) (PKG.VGL/UNIT)(REF) TYPE UNITS/CYCLE(REF) (LB) |
|---|
| TOTAL Z.7 (6.0) KG (LBS) N3 (FT3) SOLID EXPENDABLE MI/YOL REQUIREMENTS O O O O O O O O O O O O O |
| SOLID EXPENDABLE WI/YOL REQUIREMENTS OF S WI/UMIT (REF) WI/CYCLE VOL/UNIT (REF) VOL/CYCL (PKG.WT/UNIT)(REF) (DX () (PKG.VOL/UNIT)(REF) (DX () |
| |
| |
| DITAL WT. X X TOTAL WT/CYCLE (LB) TOTAL VOL/(FT ³) |
| CYCLES/DAY DAYS/MISSION YOT.WI/CYCLE KG (LB) OTAL VOL MISSION X CYCLES/DAY DAYS/MISSION X TOT.VOL/CYCLE M3 (F17) |

| SPACECRAFT Space Station | <u> </u> |
|---|--|
| HABITABILITY SUBSYSTEM Personal Hygiene | _HABITABILITY FUNCTION_Personal Grooming |
| APPLIANCE FUNCTION Shaving | |
| APPLIANCE CONCEPT NO./TITLE 3/Dry Shav | e-Windup Razor (Skylab) |
| INDEX NO. 2.3.1.3 | REF. NO. NASA JSC, G.E. |
| DESCRIPTION | |

The windup razor dry shave concept consists of a mechanical windup motor shaver with a hair particle reservoir. The unit was used on Skylab and the weight and volume figures specified are for the flight weight unit.



ORIGINAL PAGE IS OF POOR QUALITY

| | ELEC | TRICAL | POWER | REQUERE | M E N T S | | |
|---|-----------------------|----------------------------|--------------------------|--------------------------|-----------------------|---------------|---------------------------------------|
| • | (1) | | C POWE | R | D C | POWE | R |
| | CACTE TRUE TRUE | ② PEAK | (3) Average | DEMAND (WATT-I'R/ CYCLL) | (5) PEAK | 6) Average | DEMANO (WATT-HE CYCLE) |
| COMPONENT (REF) | (HR) | (WATTS) | (WATES) | (1) x (3) | (WATTS) | (WATTS) | ①x① |
| THE STATE STATE OF THE STATE OF | | | | , | | | |
| anthonic distributes a conclusive distribute and a second distribute and a sec | | | | | | | |
| To see the second of the secon | | | | | | | |
| | | | | | ************ | | |
| | | | | | | | |
| | | MUMIXAM | | TOTAL | MUMIXAM | | TOTAL |
| | | • | | | | • | |
| | | • | | | | | |
| | | THERMAL | REQUIE | REMENIS | | | |
| SOURCE | • | LATENT (BTU/HR) | | SIBLE J/HR) | HEAT .EAK (BTU/HR) | | COOLANT TU/HR) |
| ,< <u>'/.:</u> | | | ******** | | | | • • • • • • • • • • • • • • • • • • • |
| | <u></u> | | | | | | |
| -durant to the first of the second se | | | | | | _ | |
| - 1884 1887 - 1984 - 198 | | | | | | | |
| | | | | | | - | |
| • | TATO | WATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT | (BTU/HR) |
| | | | | | | | • • • |
| • | | | • | | | | |
| • | | • | • | • | | | |
| | | | | | | | |
| | | OPERATIO! | MAL PE | NALIIES | | | |
| | UEA | THERMAL | | ELECTRICAL | ME IGHT | ٧ | OLUME |
| | nea Annual | T LEAK TO C/CYCLE) (BTO |) COOLANT J/HR/CYCLE) | (PK WATTS/CY | | | /MISSION) |
| SOURCE | (810/16 | | | | | | |
| ' SOURCE $_{AI}$ $I\Delta$ | (810/11 | | | | | | |
| SOURCE | (810/11 | | | | | | |
| SOURCE 1.1 / A | (810/11) | | | | | | |
| SOURCE | (810/11 | | | | | | |
| SOURCE | (BIU/III | | | | | | |

CONCEPT 3/DRY SUBVE - WINDUP RAZOR (SKYLAB) INDEX NUMBER 2.3.1.3

| | EIXED | METCHIA | LOLUME RI | EQUIREM | ENTS | |
|------------------------|----------------------------|--|--|------------|--|--------------------------------------|
| COMPONENT BAZCK/HOL | OCK | | WEIGHT (LBS) | | | VOLUME (FT ³) 2224 |
| | | | | | | |
| ·. | TOTAL | | KG (LBS) | 977) | .ac | 063 (0224) |
| TYPE | SOLID EX UNITS/CYCLE(REF) | PENDABL (PKG. WT/UNIT (FKG. WT/UNIT (LB)) | EF) WT/CT | ici e v | I E M E N I S OL/UNIT (REF) G. VOL/UNIT) (REF (FT3) |) (FT 3) (O) x (4) (O) x (4) |
| TOTAL WT. | | | ∑③ | 770001 | Σ© | TOTAL VOL/CYCLE |
| TOTAL YOU | ¥ | AVS/MISSION AVS/MISSION | X TOT.WT/CYC (LB) X TOT.WOL/C\(FT^2\) | • | | M2 (131) |
| | ANT.USED/ | D EXPE | N D A B L E S PECOVERY FACTOR | AMT . RECO | MENIS WERID/CYCLE (LB) | AMT LOST/EVELE |
| TOTAL MT. | Σ ① | | | | Σ | |
| even | 7DAY DAYS/HI | usina tota | t 165 Y/CYCLE | (LB) | t 0 | KG (LB) |

O

| SPACECRAFT | Space Stat | ion | | - | | | |
|-------------|---------------|----------|--------------------|---|-------------|---------------------------------------|----------|
| HABITABILE | TY SUBSYSTEM | Personal | Hygiene | HABITABILIT | Y FUNCTION_ | Persona1 | Grooming |
| APPLIANCE | FUNCTION | Shaving | | namen () say test () manada la la la la la la la la la la la la la | | · · · · · · · · · · · · · · · · · · · | |
| APPLIANCE | CONCEPT NO./1 | TITLE 4/ | Dry Share | -Varuam Mot | or-Driven R | azor | |
| INDEX NO | 2.3.1.4 | | Parameters of 1146 | REF. NO | 280 | | |
| DESCRIPTION | | | | | | | |

The vacuum motor-driven razor dry shave concept consists of a vacuum driven motor with a hair particle reservoir.

The motor runs on space vacuum which turns the shaver at 2500 RPM.

D2-118561-4 CONCEPT 4/ Dry Shave - vacuum motor-driven razor . INDEX NUMBER 2.3.1.4 ELFCTRICAL POWER REQUIRENTAL (2) (3) DEMAND

ANE DALLE (WATE-197) DC POWER DEMAND (WATT-UR/ nze tille (j) (b) CYCLE PEAK AVEPAGE CYCLE) CYCLE) COMPONENT (REI) (HR) (WATTS) (WATTS) (WATTS) (WATTS) MAX I MUM TOTAL TOTAL MAX I MUM THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COCLANT SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL WATT (STU/HR) WATT (BTU/HR) MATT (BTU/HR) WATT (BTU/HR) OPERATIONAL PENALTIES THERMAL TO COOLANT LECTRICAL ME IGHT **YOL UME** HEAT LEAK . (BTU/HR/CYCLE) (BTU/IR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT3/MISSION)

C2-296

WATTS/CYCLE

(BIU/HK/LYCLE)

M1/M15510M (H1/M15510M)

KG/MISSION

(LB/MISSION)

TOTAL

WATTS/CYCLE

(BID/IM/CYCLE)

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

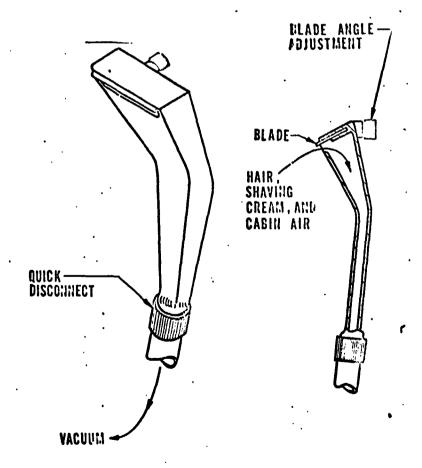
CONCEPT 4, DCY SHAVE - VACUUM MOTOR - DRIVEN KAZOK INDEX NUMBER 2.3.1.4

| | FIXED | RET G H IN | OLUME R | EQUIREM | ENTS | |
|---------------------------|--|---|---------------------|-----------|--|------------------------------|
| COMPONENT | •(REF) | | WEIGHT (LBS) | | | VOLUME (FT3) |
| RAZOR/HOLI |)CE (200, |) | 37 | | | 0045 |
| | | | | | | |
| | | | | • | | |
| | | | | | | |
| | | - | | | • | |
| | TOTAL | | .168 | (.37) | 2000 | |
| • | | • | KG (LBS) | | , 1 | M³ (FT³) ', |
| | 0 | PENDABLE (2) WT/UNIT (RE (PKG.WT/UNIT) | (E) WT/C |) YCLE | REMENIS WOL/UNII (REF) KG.VOL/UNII)(REF) | VOI / CYCLE (1) x (4) |
| | UNITS/CYCLE(REF) | (LB) | (KEF) ÛX | BY | (FT ³) | ①x (4) (FT ³) |
| | | | | | | |
| | - | | | | | |
| | | | Σ3 | | Σ | |
| | | | TOTAL W | t/CYCLE | 2. 0 | TOTAL VOL/CYCLE |
| TOTAL WT. THISSION TO CYC | LES/DAY XD | AYS/MISSION | X TOT.WT/CY (LB) | CLE | | kg (LB) |
| TOTAL VOL - CYC | ALES/DAY D | AYS/MISSION | X | YCLE | | M3 (FT1) |
| | | | | | | • |
| • | GAS/L1QU1 | D EXPEN | IDABLES ② | REQUIR | DAEED/CACTE | AMT TOSTACACTE |
| TYPE -N/A - | AMT.USED/ | CYCLE(REF) | RECOVERY FACTOR | AMT.REC | DX (C) | (LB) |
| | | | | | | |
| | | | | | | |
| | ΣΦ | | | | Σω | |
| TOTAL UT | 4 • • • • • • • • • • • • • • • • • • • | | ٠ | | _ | |
| MISSION CYCLE | TOAY NO TOAY SYNT | SSTORT X TOTAL | TIOSYTEYCLE | /(R) | | KG (LB) |

| SPACE CRAFT | T <u>Space</u> | Station | | |
|--------------------|----------------|---------------------------|---------------|------------------------------|
| PABITABIL: | ITY SUBSYSTE | M <u>Personal Hygiene</u> | HABITABILIT | Y FUNCTION Personal Grooming |
| APPLIANCE | FUNCTION | Shaving | | |
| APPLIANCE | CONCEPT NO. | /TITLE <u>5/Wet</u> Shave | -Safety Razor | /Vacuum Collection |
| INDEX NO. | 2.3.1.5 | | REF. NO | 236,206 |
| | | | | |

DESCRIPTION

The wet shave safety razor/vacuum collection concept consists of the same razor described in Concept 1 with the addition of vacuum collection. The vacuum unit used is identical to the Skylab power module. The concept is penalized for a vacuum unit based on operating time.



APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT SHOVE-SAFETY BAZOR / VACUUM COLLECTION

INDEX NUMBER 2.3.1.5

| | | ELECT | RICAL | POWER | REQUIRE | MENIS | | |
|-------------|-------|---------------------------|-----------------|-------------------------|--|----------------------|-------------------------|---|
| | | • | A | C . POWE | | | C POWE | |
| COMPONENT | (REF) | USE TIME CYCLE (HR) | PEAK (WATTS) | 3 AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) ① X ③ | ⑤ PEAK (WATTS) | ⑥ AVERAGE (WATTS) | (7) DEMAND (WATT-HR/ CYCLE) ① X (7) |
| RAZOR MOTOR | (23%) | <u>-el-i-</u> | 30 | 30 | _3.0_ | | | |
| | | | | | | | | , |
| | | | | | | | | |
| | · | | · | | | | | |
| | | | | | | | | |
| | | | • | | • | | • | <u> </u> |
| | , | | <u>.30</u> . | • | 3.0 | | • | |
| • | | | MAXIMUM | • | TOTAL | MAXIMUM | · | TOTAL |
| • | | | • | | | | | • |
| | | | | • | | | | <i>-</i> ' |

THERMAL' REQUIREMENTS

| SOURCE | LATENT (BTU/HR) | SENSIBLE (BTU/HR) | HEAT LEAK (BTU/HR) | TO COOLANT (BTU/HR) |
|-------------|---|--------------------------|--|---------------------|
| RAZOR MOTOR | | _41 | 41 | |
| | • | | Control of the Contro | |
| | Description of the Conference | | | |
| | | · | | |
| TOTAL | WATT (BTU/HR) | 12 (41) MATT (BTU/HR) | 12 (41) MATT (BTU/HR) | WATT (BTU/HR) |

OPERATIONAL PENALTIES

| _ | ••, | | rmal | ELECTRICAL | WEIGHT | VOLUME |
|--------|------------|-----------------------------|--------------------------------|------------------|----------------------------|--------------------------------------|
| 1, | SOURCE. | HEAT LEAK (BTU/HR/CYCLE) | TO COOLANT (BTU/HR/CYCLE) | (PK WATTS/CYCLE) | (LB/MISSION) | (FT ³ /MISSION) |
| | M POWER | <u> </u> | • . | | .75 | |
| CROODE | E (SKYLAB) | | | | | |
| ·} | | | | | | |
| | | 11.7 | · | | .34 | .00067 |
| · | TOTAL | MATTS/CYCLE) | WATTS/CYCLE (BTU, HR/CYCLE) | 115_(12) | KG/MISSION (LB/MISSION) | (502) H3/M15510N (FT3/M15510N) |

P2-418561-4

APPLIANCE CONCEPT REQUIPMENTS AND PENALTILS CALCULATIONS (CONCEUDED)

CONCEPT 5/WCT. SURVE - SAFETY ENEXAL/VACUUM COLLECTION INDEX NUMBER 2-3.1.5

| COMPONENT | ·(REF) | | WEIGHT (LES) | | • | VOLUME (FT3) |
|-------------------------|-----------------------|--------------------|----------------------------------|----------------------------|--------------------------|-----------------------------------|
| RAZORITUL | DER (236) | • | 7.51 21.6 | | | .656 .584 |
| BLAUCS | (236) | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | * | |
| | | | <u> </u> | | | |
| | TOTAL | | 13.2 (2 | 29.11) | .0 | 035 (1.24) |
| | | | KG (LBS) | | ! | N3 (113) |
| | SOLID EXP | ENDABLE | W T/V O L | REQUIR | EMENIS | • |
| | | (RE | (3) F) W T/CY |) CLE VOI | (REF) | AOF/CACTE |
| TYPE | ① UNITS/CYCLE(REF) | (PKG.WT/UNIT) (LB) | (REF) ①X(| 2) (PKG) | .VOL/UNIT)(REF) (FT3) | () x (4) |
| BLADLS | 733 (236) | .0587 | (2%)019: | 57 .0 | 01587 (236) | 000529_ |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | Σ3 _0195 | 7 | Σ ③ | .000529 TOTAL VOL/CYCLE |
| | | | · (LB |) | | (FT 3) |
| TOTAL WT. MISSION CY | CLES/DAY X DA | 184 YS/M15510N | X0195 TOT.WT/CYC (LB) | 7 | 9. | .8 KG (LB) |
| TOTAL VOLCY | CLES/DAY XDA | 184 VS/MISSION | x, 00052 101, VOL/CY (FT3) | (ii. | .0/ | 65 (.584) H ^{o (} (1) |
| | <u> </u> | EXPEN | | REQUIRE | | • |
| | | D | RECOVERY | AMT . RECOV | O ERED/CYCLE | AMT LOST CYCLE |
| TYPE | AMT.USED/C | B) | FACTOR | U ₍ | x ② LB) | (LB) |
| N/A | | • | | _ · | | |
| | | | | | | |
| | | - | | | | |
| | | | | | | |
| · } | Σ ① | | • | | $\Sigma \odot$. | |
| TOTAL NT | | • | | | _ [| |
| | | | | | • L | |

| HABITABILITY SUBSYSTEM 2.0 Personal | Hygiene |
|---|----------|
| | |
| HABITABILITY FUNCTION 2.3 Personal | Grooming |
| APPLIANCE FUNCTION 2.3.2 Hair Cut | ting |
| ten fanad mentelle filler felder er eller en gest sjele filler er eller en gest sjele filler er eller en gest | |
| NUMBER OF CONCEPTS CONSIDERED 2 | |

ASSUMPTIONS

- (1) The hair cutting concepts are mechanical and electrically operated with methods incorporated to retrieve cut hair particles to prevent cabin contamination.
- (2) The study assumed one haircut every 14 days for Concept 1 and every7 days for Concept 2.
- (3) Hair cutting is assumed to take 15 minutes for Concept 1 and 5 minutes for Concept 2 per haircut.

| 1.0EX NO. 2.3.2 | MAIR CUTTING | (SPACE STATION) | | | | | | | | | |
|--|--------------------------------------|---|-------------------|--------------------------------------|--|--|-------------------------------|------------------------------|---|----------|---------------------------------------|
| CONCEPT USAGE NO. TIME | CONSUMBLES AND FLOW | SINSHSHIDOSH NO | THERMAL REGRIS | 7E 0 x 1 S | ELEC PAR | RESHTS | WT/VOL REPUTS | 51.041.5 | DEVELOPMENT COST | COST | A dens de |
| USES/DAY | MS/USE (*) -KG/USE (*) (LR/USE) (*) | PRESS TEMP - LARKG DEG C- - 1851G.) (DEG F) | COOLANT SATTS! | 11 LEAK 1811 SI | 7 | A | KG. | VOLUTE | AVA 11. | M | # # # # # # # # # # # # # # # # # # # |
| | | | ••• | 33. | 50.0 | 0.05 | •:- | .01 | - | 0 | c. |
| ************************************** | | | | ÷: | 0.61 | ė o | 1.51 | .253 | - | <u>o</u> | 00 |
| ¥ | | | | (a) | 2 4 | (CTECAH ATED) |), LITERS/SEC | _ | FT ³ /81N) | | |
| 1 - PONER 2 - RAZOR | CLIFFERVACUUM COLLECTI | CT10N | | 2 - CASIN | CABIN AIR OXYGEN CCOLING WATER NATER NITROGEN | (LOST) (LOST) (CIRCULATED); (LOST) (CIRCULATED); | | | (LB/HR) (LB/HR) (LB/HR) (LB/HR) (LB/HR) | ; | • • • • • • • • • • • • • • • • • • • |
| | | DRIG De 1 | | 7 - NITROS 8 - FRECH 9 - WATER | 200552 23 23 23 23 24 25 25 25 25 25 25 25 25 25 25 25 25 25 | (USED) (CIRCULATED); (PROCESSED); | , KG/HR , KG/HR , KG/HR | | (LB/HR) (LB/HR) (LB/HR) | | |
| | | EINAL POOR Q | | (1) AVAILABLE | (**) <u>available</u> available | | (***) COST INDICA 0-25 | *)COST INDICATOR 0-25% | • | 1 | • |
| | | PAGE | · ! | (2) STATE (3) SOWE (4) EXTEN | (2) STATE OF THE ART (3) SOME DEVELOPMENT REQUIRED (4) EXTENSIVE DEV. REQUIRED | REQUIRED | * * * | 25-50% 50-75% 75-100% | | ı | |

APPLIANCE CONCEPT PAGE 14. CONCEPT NUMBER

Hair Cutting (Space Station) Concept Trade

0073409

0

()

| 319018 | RATING FOR E SELECTION (BASED | FOR EACM CONCEPT AFTER INCREASING FION PARAMETER MEIGHTING FACTOR BY ASED ON 100 % MAK POINTS) | \$ O\$ \to | |
|------------------------------------|--|--|------------|---|
| | | F & U Z O U | | |
| NORMAL | 34.45 | | | • |
| POMEN .000 VOLUME .000 THERMAL .00 | 0 35.36 0 36.26 0 34.17 0 41.34 | | | |
| DEV COST .00 | | | | |
| : | | | | |
| | | SENSITIVITY ANALYSIS | : | |
| 319R 8 | RATING FOR E SELECTION (RASED | EACH CONCEPT AFTER INCREASI Parameter Feighting Factor On 100 & Max Points) | 26 × −50 8 | |
| | | U V V O V | | |
| AL | | | | |
| Poses VOLUME | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | | | |
| | . ; | | | |
| | | | | 1 |
| | | | | , |

| | 1 | | ; | | ON ; | GIN. POOI | L PA QUA | GE I |
|------------------------------|----------|----------|--------|---------------------|----------------------|--------------|---|------|
| | | : | : | | • | i | | |
| 1 ON) | - | | | 1 | : | ; | 1 . | |
| ACE STAY | . Z | ! | | | • | ! | | |
| ING (SP | • | ! | 1 | | : | | † ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; | |
| HAIR CUTTING (SPACE STATION) | ~ | 3.66 | 00. | 13.53 | .00 | 34.45 | | |
| • . | : | 000 | 00. | | 000 | . 90. | | |
| (12/04/24) | P15 | 2 S | 01 | ~ : | . 75 | 100 | 1 1 | |
| • | MAN | 2.0500 | .25000 | 14.542 | 10.000 | 00.001 | | |
| SELECTION MATRIX | MIN | 1.5500 | .25000 | 1.4254 | .00000 | | ! | |
| 1 . | FACTOR . | PE I GHT | VOLUME | THERMAL RELIAB-Y | DEV COST TOTAL PT | Sultan | | |
| ; | 1 . | , | İ | | : | ! | ! | |

C2-306

(°)

| | ! | | | | : |
|----------------------|---|-----------|----------------------------------|-----|-----|
| | - | ~ | | : | : |
| MORMAL | • | 34.45 | | ; | , |
| POSES | 00. | 35.36 | | : | |
| VOLCAR. | 90 | | | : | |
| RELIA6-7 OFV COST | 68 | 38.50 | | , ; | · i |
| | ; | | | | : |
| | , | | | | , |
| | | 38 | FRSITIVITY ANALYSIS | 1 | ; |
| | 219R18 | RATING FO | DR EACH CONCEPT AFTER INCREASING | | |
| | | IBASE | 0 | | |
| | | | 1437807 | • | |
| | - | ~ | | | |
| MORNAL | • • • • | 36.45 | | | |
| •С16нт | • 00 | 37.74 | | | • |
| NO COLOR | 335 | | | | |
| RELIABAT | ; | 34.26 | | | |

007340!

| | TAT: | . | ; | • | | |
|--|--------------------------|-----------|------------------|-------------|----------------------|-----------|
| | ISPACE S | 2 0 | ı | | , | |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | HAIR CUTTING (SPACE STAT | ~ | 3.66 | 13.53 | 00.5 | .00 27.34 |
| 100 (81CH) | • | ! ! !- | 000 | 5 8 | 3 6 | 00. |
| DOCLANT LEAK 1 2 - SY | (12/00/21) | \$1 | 21 5 | 01 | 2 | 100 |
| UTINE D V - DIRECT TO COCLANT V - CABIN MEAT LEAC LESSKATT) TYPE 1 .7 LESSKATT) TYPE 2 .5 | , | AALUE | 2.0560 | 14.592 | 1.0000 | 100.00 |
| C SCARDCTINE C PERALTY - C PER | SELECTION MATRIX | MIN | 1.5500 | 1.4254 | | 00000 |
| USES NOD SUGROUTINE TATERAL PERALTY - D THERRAL PERALTY - C POSER PERALTY (LBS) POSER PERALTY (LBS) | | FACTOR | AE 16MT POAER | THERMAL | RELIABOT DEV COST | TOTAL PT |
| 1 1 | i i | : | • | ሶ ን_ | 3 Uъ | . !• |

| MORMAL .00 36.45 | | |
|------------------|---|---|
| 000 | | |
| 000 | | |
| | | |
| 200 | | |
| | | |
| | SENSITIVITY AMALYSIS | 1 |
| SINGLE SCLECTION | NG FOR EACH CONCEPT AFTER INCREASING SCTION PARANETER FEIGHTING FACTOR BY -50 % LBASED ON 100 % FAR POINTS? | |
| | | : |
| NORMAL | | |
| | | |
| 7. | | |
| | | |

| ì | 1 | , | D2 11 | 1 | • | ••• | , | , | • | , | | 1 | | | |
|---------------|----------------------|---------------------------------------|---------------|----------|---------------------------------------|--------|---|--------|--------|----------|---------|----------|-----------|----------|--------|
| | | | | .: | • | ! | | | i i | | | | | | 1 ' |
| ì | ; | ; ; | | ı | : | | 1 | | | - | | | | | : |
| | • | | | • | | ! ! | | | | ! | | | | | |
| | | | | | : | | : | | | | | ! | | 1 | ! |
| | - DA | | | : | · ; | ļ | | | | | | : | | | |
| GINAI POOR | QÜ | ALL | | | . | ! | | ! | ! | | | i | | ; | |
| | • | ! | | | | | | | ! | | | 1 | | ! ! | |
| | ı | | | <u> </u> | | | | : | ! | | | | | · | |
| | : | | | | | | | † † | | | • | • | | ; ; | |
| | 1 | | | İ | · : | ! | | | į | | | | | : | |
| i | } | : | | ! | 17 TON | į | - | i i | | | | | | | |
| ; | | | | į | F 5 | : | U X | | | | | | | | |
| | | | | | (SPAC | | ن U | ! ! | | | | | | ! | |
| | | 0 7 | | | CUTTING (SPACE STATION | | | | | | | ! | | | |
| | , | 52 | | | | | | | 1 | 2 6 | | 00 | 00. | *** | 5. |
| | | 155 E | | İ | # # # # # # # # # # # # # # # # # # # | | | i | | ; | | | _ | -27. | • |
| | | 25.00 | 0.45 0.45 | | • | | 4 | - | .00 | 9 | 9 5 | 38 | 00. | 9. | 00. |
| | ARSI | | • | İ | (12/00/21) | . | | 138 | 51 | - | [3 d | | <u>\$</u> | 7.5 | 001 |
| | (S.00 TEARS) | TO COOLENT Eat Leak | 1466 2 | | Ž | | | | | | | ! | _ | ! | |
| | 6 (5. | * | | | X E | | HAM | 30788 | 2.0503 | 1030 | 00652 | 9000 | 3.000 | 75.500 | 100.00 |
| 1 | 1626.0 | - DIRECT | (CBS/8411) | : !. | 144 | | | : | ~ | - | • • | | | • | |
| | S - 1 | 22 | | , | CT 10 | ' ! | ======================================= | 3078 | .5500 | 7.745 | 06052 | | 10.000 | 000 30• | 20000 |
| į | NUMBER OF DAYS . 18. | THERMAL PENALTY THERMAL PENALTY | POSER PENALTY | | "SELECTION MATRIX | i | | > | 5 - 1 | • | | | | ! | 96. |
| ! | 1 400 i | THAL. | i i | ! | 1 | , | | 104 | 144 | <u>.</u> |) H | #EL148-Y | DEV C05T | TOTAL PT | 921 |
| 1 | NCN USES | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | . ; | | FACTOR | | | Jun Jok | 1738 | DEV | 101 | RATING |
| | i | | <u> </u> | 1 | i | | | i | 1 | į | | i | | 1 | !! |

| S BY 50 8 | | ORIG | | R C | AG | |)R BY =50 & | | | | | |
|---|---------|--------|------------------------|--------|-----------|----------------------|--|-----------------|-----------|----------------|--------|-----------|
| SINGLE SELECTION PARAMETER WEIGHTING FACTCI | CONCEPT | 00 36 | .00 35.36 .00 36.26 | 41.34 | .00 33.14 | SENSITIVITY ANALYSIS | SINGLE SELECTION PARAMETER REIGHTING FACTO | CONCEPT CONCEPT | ch.45 00. | .00 37.79 | | .00 34.26 |
| | | NORMAL | PONER | VOLUME | DEV COST | | | | MORMAL | POLER POLER | VOLUME | AEL 148-Y |

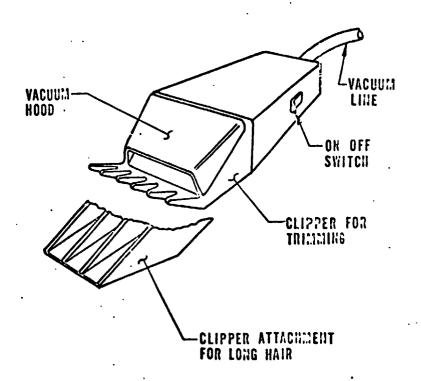
APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 2.3.2-HAIR CUTTING

| | NUMBER OF SAFETY CRITICAL ITEMS | 00 | |
|---------|---------------------------------|--|---|
| | . 0 | | · |
| | 0 | • | |
| | 0 | | |
| S | 0 | | |
| F | 0 | , | |
| 0 N E | 0 | | |
| ۵. ک | 0 | | |
| 0 0 | 0 | | |
| 0 F | 0 | | |
| | 0 | *************************************** | |
| 8 E R | 0 | | |
| 2 | | | |
| Z | 0 | | |
| | | | |
| | 0 | | |
| - | ੜੋਂ 8010M⊕ | | |
| | COMPONENT TYPE | CTION | |
| | PONEN | COLLE | |
| | | וכנונות א כסר | |
| İ | TYPE | PER/V | |
| | ANCE | CL IPI COMB, | |
| | APPLIANCE TYPE | POWER CLIPPER/VACUUM COLLECTION RAZOS COMB/VACUUM COLLECTION | · |

| SPACECRAFT Space Station | |
|------------------------------|---|
| HABITABILITY SUBSYSTEM Perso | nal Hygiene HABITABILITY FUNCTION Personal Grooming |
| APPLIANCE FUNCTION Hair Cu | tting |
| APPLI NCE CONCEPT NO./TITLE_ | 1/Electric Clipper/Vacuum Collection |
| INDEX NO. 2.3.2.1 | REF. NO236,207 |
| DESCRIPTION | |

The electric clipper/vacuum collection concept consists of an electrically driven clipper with vacuum collection of the hair clippings. The clipper is similar to the terrestrial barber type. The unit used for vacuum collection is the power module used on Skylab. A hood is employed over the clipper area to assist in the pickup of the hair clippings.



APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS LONCEPT ILECTRIC CLIPPUR /VACUUM CULLE CTICAL

INDEX NUMBER 2.3.2.1

| AC PONTR DC PONTR USE TIME O DEMAND S DEMAN | |
|--|----------------------|
| COMPONENT (REF) (HR) (WATTS) (WATTS) (WATTS) (WATTS) (WATTS) MOTOR (2%) 14 . SO SO 7 MAXIMUM TOTAL MAXIMUM I HERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAR TO COULD (BTU/HR) (BTU/HR) (BTU/HR) FOR (256) — 1/4 1/4 — MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) OPERATIONAL PENALLIES NEAT LEAR TO COULANT ELECTRICAL METGHT VOLE SOURCE (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) WATT (BTU/HR) MATT (| (i |
| COMPONENT (REF) (MR) (WATTS) (| (7 DEMA (WATT- |
| THERMAL REQUIREMENTS LATENT SCHISTBLE HEAT LEAK TO COME (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) WATT (BTU/HR) NATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) OPERATIONAL PENALTIES THERMAL REQUIREMENTS SOURCE (BTU/HR) STATE (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) NEAT LEAK TO COOLANT ELEC/RICAL METGHT WOLL SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/HISSION) (FT ³ /M) | CYCLE (1) X(|
| THERMAL REQUIREMENTS LATENT SCHOLLE MEAT LEAR TO COM SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (ETU/HR) OPERATIONAL PENALTIES THERMAL PENALTIES THERMAL PENALTIES NEAT LEAK TO COOLANT ELEC/RICAL MEIGHT WOLL SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/HISSION) (FT ³ /HI | (i)x(|
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) WATT (BTU/HR) WATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLCE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL WEIGHT WOLK SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLK SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLK SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLK SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLK SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL 33.4 (114) 33.4 (114) MATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK THERMAL TO COOLANT ELECTRICAL WEIGHT WOLK SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /MI | <u> </u> |
| I HERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) MOTOR (2.56) — //4 //4 //4 //4 TOTAL 33.4 (1/4) 33.4 (1/4) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES NEAT LEAK THERMAL TO COOLANT ELECTRICAL MEIGHT VOLU (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | |
| SOURCE (BTU/HR) SENSIBLE HEAT LEAK TO COOL MOTOR (256) — 1/4 //4 //4 TOTAL 33.4 (1/4) 33.4 (1/4) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES THERMAL TO COOLANT ELEC/RICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | ATOT |
| SOURCE (BTU/HR) SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL TOTAL DEFRATIONAL PENALTIES HEAT LEAK TO COOLANT ELEC/RICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | |
| SOURCE (BTU/HR) SENSIBLE HEAT LEAK TO COL MOTOR (2.56) — 1/4 //4 //4 TOTAL 33.4 (1/4) 33.4 (1/4) MATT (BTU/HR) MATT (BTU/HR) MATT (BTU/HR) MATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELEC/RICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| SOURCE (BTU/HR) SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL TOTAL DEFRATIONAL PENALTIES HEAT LEAK TO COOLANT ELEC/RICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | |
| SOURCE (BTU/HR) SENSIBLE HEAT LEAK TO COC SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL TOTAL DEFRATIONAL PENALTIES HEAT LEAK TO COOLANT ELEC/RICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | |
| SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL TOTAL MATT (BTU/HR) MATT (BT | |
| TOTAL DEERATIONAL PENALTIES NEAT LEAK TO COOLANT ELECTRICAL MEIGHT VOICE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK MATTS/CYCLE) (LB/MISSION) (FT3/MI | OLANT |
| TOTAL MATT (BTU/HR) | /HR} |
| TOTAL MATT (BTU/HR) | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/HISSION) (FT3/M) | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| WATT (BTU/HR) WATT (BTU/HR) WATT (E OPERATIONAL PENALTIES HEAT LEAK TO COOLANT ELECTRICAL WEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (LB/MISSION) (FT3/MI | |
| OPERATIONAL PENALTIES THERMAL HEAT LEAK TO COOLANT ELECTRICAL MEIGHT VOLE SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/HISSION) (FT³/ME | |
| QPERATIONAL PENALTIES THERMAL HEAT LEAK TO COOLANT SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/HISSION) (FT³/MI | atu/HR |
| THERMAL ELECTRICAL MEIGHT VOLO SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /M | |
| THERMAL ELECTRICAL MEIGHT VOLO SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /M | |
| THERMAL ELECTRICAL MEIGHT VOLO SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /M | |
| THERMAL ELECTRICAL MEIGHT VOLO SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /M | |
| HEAT LEAK TO COOLANT ELECTRICAL MEIGHT VOLE SOURCE (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| HEAT LEAK TO COOLANT ELECTRICAL MEIGHT VOCE SOURCE. (BTU/HR/CYCLE) (BTU/HR/CYCLE) (PK WATTS/CYCLE) (LB/MISSION) (FT ³ /MI | |
| • | |
| VACCIUM POWER 11.14 - 115 DE CO | 122104 |
| | 49) |
| MODULE (SKYLAB) | |
| talan ang ang ang ang ang ang ang ang ang a | |
| · · · · · · · · · · · · · · · · · · · | |
| | |
| 3.3 .022 | |
| TOTAL (11.19) - 115 (10) (.05) (no | |

WATTS/CYCLE (BTU/HR/CYCLE)

(.05) KG/MISSION (LB/MISSION)

(LL) MISSION

(11.14)
WATTS/CYCLE
(BTU/HR/CYCLE)

APPLIANCE CONCEPT PEQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

| MPONENT | ·(RI | | HITY OLUME REQU WEIGHT (LSS) | | VOLUME (FT ³) |
|-----------------------|--|-------------------------------------|--|---|--------------------------------------|
| LIPPUK/IR | OLDER (Z. | 36) | 2.0 | | .25 |
| | | | | | |
| | | | | | |
| | 10 | ral | .907 (2.0 | 2)] | 0071 (.2. |
| | | | KG (LBS) | <u>.</u> | M³ (FT³) . |
| TYPE | <u>\$ 0 L 1 D E</u> (1) UNITS/CYCLE(RE | (PKG.WT | B L E W 1/V O L R (2) (3) IT (REF) WT/CYCL E /UNIT)(REF) (1) X (2) (LB) | E Q U I R E M E N T S VOL/UNIT (REF) (PKG. VOL/UNIT) (RI (FT3) | S VOL/CYCLE (FT ³) |
| -N/A- | | | | | - |
| | | | | | |
| - | | <u> </u> | ∑3 | ΣtE Σ | TOTAL VOLVEY |
| TAL WT ISSION | CLES/DAY X | DAYS/M:SSI | TOT.WT/CYCLE (LB) | • | KG (LB) |
| TAL VOL MISSION CY | CLES/DAY X | DAYS/MISSI | x | | M ³ (F) ¹) |
| | <u>6 A S/L 1 Q U</u> | | PENDABLES RE | QUIREMENIS (3) | • |
| | · AMT.US | ① LD/CYCLE (REF ' (LB) | ****** | MT.RECOVERED/CYCLE OX (LB) | AMT LOST/CYC ① - ③ (LB) |
| TYPE - N/A - | | · | <u> </u> | | |

(18)

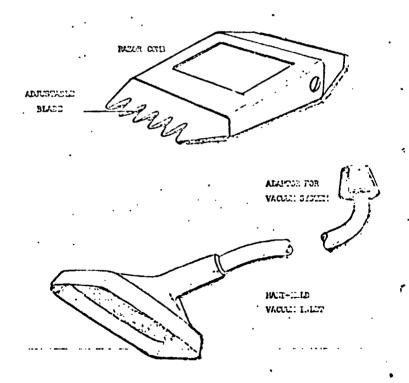
(z (1)

- X ---DAYS/MISSION X TOTAL TOSTYCYCLE **

| SPACECRAFT | Space Station | | |
|-------------------|--------------------|--------------------------|------------------------------|
| HABITABILI | TY SUBSYSTEM Perso | onal Hygiene HABITABILIT | Y FUNCTION Personal Grocming |
| APPLIANCE | FUNCTION Hai | r Cuttinj | |
| APPLIANCE | CONCEPT NO./TITLE_ | 2/Razor-Comb/Vacuum Col | lection |
| INDEX NO | 2.3.2.2 | REF. NO | 236,207 |
| | • | | |

DESCRIPTION

The comb/vacuum collection concept consists of a razor comb with a hand-held vacuum pickup device. The concept requires two men to operate which is a disadvantage from the crew time aspect. The unit used for vacuum collection is the power module used on Skylab.



D2-118561-4

0/5

| NACUUM POWER MODULE (SKYLAB) | // | '.14'_ | | | | (neg) |
|---------------------------------|-------------|--------------------|--------------------------|----------------------------------|---|--|
| SOURCE. | (BTU/HR | /CYCLE) (BT | O COOLANT U/HR/CYCLE) | ELECTRICAL (PK WATTS/CY | WEIGHT CLE) (LB/MISSIO | VOLUME N) (FT ³ /HISSION |
| • | . 9 | PERAILO | NAL PE | NALILES | •• | • |
| | · | • | • | | • | |
| | | | | | | • |
| | DTÁL | WATT (BTU/HR) | WATT | (BTU/HR) | WATT (BTU/HR) | FATT (BIU/HR) |
| *** | | | - | | general desiration of the second section of the section of | named to see the see of the |
| | | | - | | | |
| | | | | | | **** |
| - N/A- | | | <u> </u> | | | |
| SOURCE | | LATENT (BTU/HR) | | ISTBLE 'U/HR') | HEAT LEAK (BTU/HR) | (BTU/HR) |
| | | I H E R M A L | REQUI | REMENIS | | • |
| | | | | | | • |
| • | | · | , | TOTAL . | MAXIMUM | ATOT . |
| | | MAXIMUM | • | 7074 | AAR W TANAM | |
| | | | | , | | |
| | | | | | | |
| | | | | - | | |
| N/A = | ····, | | | | | |
| COMPONENT (REF) | CYCLE (HR) | PEAK (WATTS) | AVERAGE (WATTS) | (WATT-HP/ CYCLE) (1) X (3) | ⑤ PEAK (HATTS) | 6 DEMM AVERAGE (WATTS) |
| | USE TIME | ^ | C . POW | DENAND | <u> </u> | POWER |
| | ETEC | IRICAL | POWER | REQUIRE | MENIS | |

WATTS/CYCLE (BTU/HR/CYCLE)

.022 (.05) (C/MISSION)

MYMISSION)

115 (vc)

3.27
(11.14)
MAITS/CYTLE
(BTU/HR/CYCLE)

TOTAL

APPLIANCE CONCEPT PEQUINCHENTS AND PENALTIES CALCULATIONS (CONCLUDED)

CONCEPT Z/R/12014 - CONB/VACUUM COLLECTION INDEX INDEX NUMBER 2.3.2.2

| MPOMENT PUBCIZ COUNC | EIXED (REF) B/HULUXE (236) | ME18H7/ | KEIGHT (LBS) /-5 | | I MENIS | VOLUME (113) . 25 |
|-------------------------|--|---------------------------------|--------------------------|-----------------------|--|---|
| TYPE -N/A - | TOTAL SOLID EXP UNITS/CYCLE(REF) | ENDABL WT/UNIT (PKG.WT/UNI (LB) | REF) VI | | VOL/UNIT (REF) (PKG. VOL/UNIT) (RE (FT3) | 007 (25) N ³ (FT ³) VOL/CYCLE (D x (4) (FT ³) |
| AL VOL = | x | YS/MISSION YS/MISSION | XX | 7cvčle ^{— -} | Σ | ************************************** |
| TYPE - N/A | <u>G A S/L 1 Q U 1 D</u> AMT.USED/C (L | D | NDABLES RECOVERY FACTOR | REQUI | REMENIS RECOVERED/CYCLE (LB) | AMT LOST/CYCLE O-3 (LB) |
| AI WT | ΣΦ | 310¥ X 101 | ALTOSYZEVELE CZ (Q) | (LB) | Σ⊙ | KG (LB) |

| HABITADILITY SUBSYSTEM 2.0 Personal Hygiene | |
|---|--|
| HABITABILITY FUNCTION 2.3 Personal Grooming | |
| APPLIANCE FUNCTION 2.3.3 Nail Care | |
| NUMBER OF CONCEPTS CONSIDERED 2 | |

ASSUMPTIONS

- (1) The nail care concepts considered are manual operations using bag and vacuum collection of nail clippings.
- (2) The study assumed nail cutting once every 14 days.
- (3) Nail cutting is assumed to take 5 minutes per use.

| 100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | CONCEPT USAGE | , ! , | CONSURABLES | AND FLO | 8 REQUIREHENTS | #E21\$ | THERMAL | ر 46(| REC115 | ELEC PUR RESUTS | RESHTS | • | | E C | סנגנו | 7 | A Jacos 3 a |
|--|---------------|-------------|--|---------|---|------------------|---------------------|-------|-----------------|-----------------|----------------------------------|-------------------------|------|--|--|-----------|-------------|
| CONCERT NAME (*) CONCERT NAME | USES/O | | A44. PC USCO 1 - KG/USC- (LE/USC) | | 18 16 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 75.1 105.6 C- | COCCANT - 1847-15-1 | i i | LEAK | | | ' * ; | | | A 4 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | H L D D L | # 1 |
| CONCEPT NAME (**) CONCEPT NAME (**) CONCENT (1987) CONTEST NEED CONTEST (1057) CONTEST | | DO | | | | | • • • | • | | 0.0 | • | _ | - 15 |) | - | • | - |
| (*) - CABIN AIR (CIRCULATED), LITERS/SEC 2 - CABIN AIR (LOST) (1051) (10 | | 00 | | | , , | 1 | - | - | ; ; | 115.0 | ••• | • : | -: | 600 | - | 2 | - |
| - manual mail Clipper | 1 | | ;- &. • | | ! . ! | | · | | ε | | _ | ICULATE | | TERS/SE | _ | (RIE) | |
| Solution | • • | TAL NA | AL CLIPPER | | ECTION | | , 1 | | - (4 t) - 4 H D | | E | ST) ST) SCULATE SCULATE | | ##//################################## | - | TTTTTT | |
| ADDE (1) AVAILABLE (1) AVAILABLE (2) STATE OF THE ART (2) SCORE DEVELOPMENT REQUIRED (4) EXTENSIVE DEV. REQUIRED | | | | | | | OI, | I | - | | 308 | SCULATE OCESSED | | KH/0 | (2) | EFF. | |
| (2) STATE OF THE ART (3) SOME DEVELOPMENT REQUIRED (4) EXTENSIVE DEV. REQUIRED | 4 ' | | | ! | | , | RIGINA POOD | | Ξ | | 삨 | | ڪ | 1800S 1801C 1801C | 7 5% | | : |
| | | | | | ; ; | WOAL | U PAG | . 1 | ೭೮೮ | | IE ART IPPENT RE IEV. REGU | QUIRED IRED | | 25-5 50-7 75-1 | # # 00 00 00 00 00 00 00 00 00 00 00 00 00 | | |

9 /3399 (

5 YIAR PAGE 11. CONCEPT NUMBER

Nail Care (Space Station) Concept Trade

| OF POOR | PAGE IS |
|---------|---------|
|---------|---------|

| | SELECTION MATRIX | ATRIX . | (12/00/24) | • | MATL CU | TTING | (35) | , | STAT | 104) | , |
|----------|------------------|--------------|------------|-----------|---------|-------|------|-------------|------|------|---|
| FACTOR | MIN | *AR VALUE | P.15 | • | ~ | | ٠ | 0 N C E P T | w | • | |
| PE 1611 | , 00000 | 1.8300 | 5 | 11.07 | 020 | : | | | í | , | |
| POPER | 00000 | 67.965 | 5 | 15.00 | Co. | | | | | | |
| VOLUME | •123n0-02 | 10-00004. | 0 | 0 8.0 | 00. | : | ; | ; | ; | , | ì |
| THERMAL | • 00000 | .71680 | 5 | 15.00 | • 00 | | | | | | |
| DEV COST | 5.0000 | 20.000 | S 1 | 11.25 | 00. | ! | į | ı | ; | ; | |
| TOTAL PT | 00000 | 70.000 | 2, | 42.12 | 00. | | | ; | ; | | ; |
| RATING | 0000° | 100.00 | 100 | 100 86.74 | 00 | | | | | | |

OF POOR QUALTU

| | | ~ | |
|------------------------|------------|-----|-------|
| 1.8330 | 15 11.07 | 0 | i |
| .03300 67.965 | 15.03 | 00. | |
| -02 | .09.4 6: | 00. | ! |
| .00000 | 15.00 | •00 | |
| 5.0000 | 15 11.25 | 00. | |
| TOTAL PT .00000 70.000 | 70 . 62.12 | 00. | ; |
| 00.001 00000. | 100 66.74 | 00. | |

0.73.01

| FPT AFTER INCREASING REJENTING FACTOR BY SO B | | | | | S 11 | AFTER INCREASING GHTING FACTOR BY "50 S POINTS! | | | | : |
|--|-----------|--------|---|-----|----------------------|---|-------------|--------|--------------|---|
| RATING FOR EACH CONCEPT A SELECTION PACAMETER REIG IBASED ON 100 S MAX P | C 0 M C E | | 000. | | SENSITIVITY ANALYSIS | SELECTION PARANETER BEIG BELECTION PARANETER BEIG 18ASED ON 100 B MAN P | 2 J.N. 0-3. | 00. | 00. | 000 |
| 174 219415 | · - | | | ! | | 8146LE SE | • | | 40.53 | 67.36 |
| ! | : | JANAON | WELENT POLCE WOLLING THERMAL DEV COST | | • | | | MORMAL | BEIGHT POREL | VOLUNG VOLUNG THERMAL DEV COST |
| , | . (| r | 0 0 | · (| O | C . | • | | | |

| 15 11 07 15 15 00 00 15 15 15 00 00 15 15 00 00 15 15 00 00 15 15 00 00 00 00 00 00 00 00 00 00 00 00 00 | |
|--|--|
| | MAX VALUE 1.8300 67.965 .6000-01 .71680 .71680 .71680 .71680 |

| 1 | | | | |
|----------|--------|------------------------------------|--|----------|
| i | SINGLE | RATING FOR SELECTION (BASED | R EACH CONCEPT AFTER INCREASING IN PARAMETER WEIGHTING FACTOR BY SO SED ON 100 SE MAX POINTS! | |
| | | - - | T B B T | |
| | - | ~ | | |
| NORMAL | 73.08 | 17.65 | | OP, |
| MEIGHT | 73.13 | 16.22 | and the second s | IG P |
| 1 | 75.26 | 16.22 | | IN OC |
| VOLUME . | Ŧ (| 16.67 | | IA DR |
| THERMAL | 75.76 | 16.22 | The same of the same state of the same of | L |
| C05T | 73.23 | 16.27 | | P. QU |
| | | | | AGE I |
| | ; ; | U | ATALITICAL AND VIOLENT AND VIO | 3 |
| | - | | | : |
| | SINGLE | RATING FOR Selection If Ased | IR EACH CONCEPT AFTER INCREASING IN PARAMETER WEIGHTING FACTOR BY -50 % D'ON 100 % MAX POINTS) | |
| ! | | , | | * |
| ! | ·- | ~ | | • |
| NORMAL | 73.08 | 17.65 | | |
| WE I GHT | 73.01 | | | |
| • | 70.47 | 19.35 | . The same of the | |
| THERMAL | 70.47 | 19.35 | | |
| OST | | 19.35 | The second secon | |
| 7007 | | | | |

01**733**97

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

APPLIANCE FUNCTION: 2,3,3-NAIL CARE

| | NUMBER OF SAFETY CRITICAL ITEMS | | | | |
|------------|---|-------------------------------------|---|---|---|
| | | | | | |
| | |) | • | | |
| | C | | | | |
| ENTS | . (| ENTS. | | | |
| 0 0 | | COMPON | | | |
| C 0 M | | TRICAL | | | |
| 0 F | C | NO MECHANICAL/ELECTRICAL COMPONENTS | • | | |
| <u>د</u> ا | . (| ECHANIC | | | |
| M M | |) W | | | |
| 2 | | | | | |
| | | | | | |
| | C | | • | | |
| | NO. | | | | |
| | COMPONENT 1 TPE | | | | |
| | | | | • | |
| | APPLIANCE TYPE | | | | • |
| | APPLIA | · | | | |

D2-1185C1-4

| SPACECRAFT | Space Station | |
|-------------------|----------------------|---|
| HABITABILI | ITY SUBSYSTEM Person | nal Hygiene HABITABILITY FUNCTION Personal Grooming |
| APPLIANCE | FUNCTION Nail Ca | ire . |
| APPLIANCE | CONCEPT NO./TITLE_ | 1/Manual Nail Clipper/Bag Collection |
| INDEX NO | 2.3.3.1 | REF. NO236,207 |

DESCRIPTION

The manual nail clipper/bag collection concept consists of a terrestrial type nail clipper enclosed by a bag to contain nail clippings. The bag incorporates a finger cuff and ring to form a seal around the finger during nail cutting. The collection bag is transparent to observe nail clipping.

D2 418U(1/4)

| | EIEC | | POWĘR | REQUIR | | | |
|--|-------------|-----------------|---------------------------|--------------------------------------|------------------------|---------------------------|--|
| | - | Λ | C POWE | R | D.C | РОН | R (7) |
| OMPONENT (RE | | (MVLL2) DEVK | (3) AVERALE (WATTS) | (4) DETMAD (WAIT-HR/ CYCLE) (1) X(3) | (5) PEAK (WATTS) | (6) AVERAGE (WATTS) | (j) x (j) CYCLI) CYCLI) (I/AII-III (X) |
| | | | | | | | |
| a garante de designation de la company de seguine de la company de la co | | | | | | | |
| | | | | | | | |
| | | | | | • | | |
| | | | | | | | |
| | | | | | | | |
| dies appropriate en fact des riches in in de les en en con- | | | | | | | |
| | | NUMIXAM | | TOTAL | MUMIXAM | | TOTAL |
| | | <u> </u> | R E Q U I I | REMENIS | L. | | |
| | - | LATENT | SEI | SIBLE | HEAT LEAK | TO | COOLANT |
| SOURCE | | (BTU/HR) | (81) | ſλ i uδ) | (BTU/HR) | (| BTU/HR) |
| 11/: | | | | | | | |
| | **** | | | | | | |
| | | | | | | | |
| ** ** *** *********************** | | | | - | | | |
| | | | | | | | |
| | | | | | | | |
| | 70711 | | | | | | |
| | TOTAL | WATT (BTU/HR) | WATT (| (BTU/IIR) | WATT (BTU/HR) | L'AT | T (BTU/HR) |
| | | | • | (010)1111 | WALL (BIO) IN | n/\; | i (bio)nk) |
| | | | | | | | |
| | | | • | | | | |
| | | | | | | | |
| | | <u>DPERATLO</u> | IAL PE | NALTIE | <u>s</u> | | |
| | | THERMAL | | ELECTRICA | L WEIGHT | | VOLUME |
| SOURCE | (BTU/HR | |) COOLANT J/HR/CYCLE) | (PK WATTS/C | | ON) (F1 | 3/MISSION) |
| | • | | | | | | |
| | | | | | <u> </u> | | |
| | | | | - | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | **** | - | | |
| | | | | | | | |
| | TOTAL | | | | | | |

D2-1185(1-4

APPLIANCE CONCEPT PEQUIPEMENTS AND PENALTIES CALCULATIONS (CONCEDED)

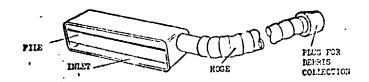
CONCEPT // MANUAL NA L CLIPPUR/BAG COLLECTION INDEX NUMBER 2-3.31

| T. T. | X E D | MEIGHIV. | | REQUIR | T D F B T 7 | |
|---------------------|------------------------------|--------------------------|-------------------|---|---|-------------------------------------|
| COMPONENT | •(REF) | | WEIGHT (LBS) | | | VOLUME (FT [*]) |
| NAIL CLIPPUR/BAG | (236) | | .48 | | | .0012 |
| | | | | • | | |
| | | | | | | |
| | | | | | *************************************** | |
| | | | | | | · |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | , | | | | |
| | TOTAL | . L | .2177 | (.48) | .000 | 0012) |
| | | | KG (LBS) | | , | M ³ (FT ³) . |
| 50110 | C Y D | r n n a r i | F 9 T/V 0 I | P C O !! | 1 D F M F N T C | • |
| <u> </u> | EAL | ENDABL ② | | 3 | <u>IREMENTS</u> (4) | (5) |
| (| D | WT/UNIT (! PKG.WT/UNI | REF) WT/ | X(S) (CACFE | VOL/UNIT (REF) (PKG.VOL/UNIT)(REF | VOL/CÝCI E |
| TYPE UNITS/CY | | (LB) | (| (LB) | (FT³) | (FT3) |
| COLLECTION BAG O.L. | (2,26) | | _(236) <i>0</i> 0 | 167 | 0555 | .00093 |
| | | | | | | · |
| | | | | | | |
| | | | | | | · |
| | | | | | | - |
| | | | | | | |
| | | | Σ 3 .60 | 167. NT/CYCLE (LB) | Σ (§ | 101AL VOL/CYCLE |
| | | | 101/12 | (LB) | | (FI3) |
| TOTAL WT. 429 | x | 194 YS/M15510N | x .001 | 67: | .03 | 59 (.13) |
| CYCLES/DAY | DA | YS/MISSION T | 101.WI/C | YCLE | | KG (LB) |
| TOTAL VOL | | 101 | (20) | , ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | 501 7 a 7 21 |
| Mission " | - ^X _{DA} | 184 VS/MISSION T | X000° | 93 LYLLE | |)21 (.073) M (11) |
| | | • | (FT ³ | ') | | |
| | | | | • | | • |
| G A S/L | <u> </u> | EXPE | NDABLES | REQUI | REMENIS | |
| | | D | 0 | 4407 | 3 RECOVERED/CYCLE | AMT LOST/CYCLE |
| | MT.USED/C | YCLE (REF) | RECOVERY | AMI. | OXO (LB) | 0-3 (LB) |
| TYPE AL /A | , (r) | B) | FACTOR | | (LB) | (LB) |
| | | • | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 70 | | | | | <u>~~</u> | - |
| Σ (1) | | | • | | Σ (0) | • |
| TOTAL WT | | • | | | _ ! | |
| CYCLE/DAY X | ΅ϦΑΫ϶ϔͱϔͿͺϾ | 5107 X Yo 17 | NETTO STYCYCLE | | • <u> </u> | KG (LB) |
| | | | a (0) | (LB) | t (1) | • • |

D2-118561-4

| SPACECRAFT Space Station | • | |
|--|--------------|----------------------------|
| HABITABILITY SUBSYSTEM Personal Hygiene | HABITABILITY | FUNCTION Personal Grooming |
| APPLIANCE FUNCTION Nail Care | | |
| APPLIANCE CONCEPT NO./TITLE 2/Metal Nail | File/Vacuum | Collection |
| INDEX NO. 2.3.3.2 | _REF. NO | 236,207 |
| DESCRIPTION | | • |

The metal nail file/vacuum collection concept consists of a nail file with vacuum collection of nail filings. The file has a hood around the file to improve the vacuum collection efficiency. The concept is penalized for a vacuum unit based on operating time. The vacuum unit used is identical to the Skylab power module.



D2-J18561-4

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCEPT 2/METAL NAIL FILE / VACUUM COLLECTION

INDEX NUMBER 2.3.3.2

| • | | IRLCA | | WER POWE | REQUIR | EME | | C P | 0 W F R |
|----------------------|---------------------|-----------------|--------------|------------------|--------------------------------|----------|-----------------------|-------------|---------------------------|
| COMPONENT (REF) | USE TIME CYCLE (HR) | PEA (WATT: |) K A | ③ .VERAGE WATTS) | DEMAND (WAIT-HR/ CYCL f) | | (§) PEAK WATTS) | | DEIM MATT- CYCLE |
| | | | | | | | | | |
| • | | HAXIH | • JM | · | TOTAL | | AXIMUM | | ATOTA |
| | . • | <u>THERM</u> | <u>A L'R</u> | EQUI | <u>R E M E N T :</u> | <u>s</u> | | • | |
| . SOURCE | | LATENT | ī | SEN | SIBLE U/HR) | 1 | HEAT LEAK (BTU/HR) | | TO CCOLANT (BTU/HR) |
| N/A | • | | | | | | | | |
| | | • | | | - | | | | |
| 10 | TAL | WATT (BTU | I/HR) | WATT | (BTU/HR) | WAT | TT (BTU/HF | | WATT (BTU/HR |
| • | | | | | | | | | • |
| · | , HEA | T LEAK | RMAL TO COO | DL ANT | NALTIE ELECTRICA | NL. | WEIGH | | VOLUME |
| SOURCE VACUUM POWER | | 1/CYCLE) 5.6 | (BTU/HR, | CYCLE) | (PK WATTS/C | YCLE) | (LB/M155 | 3 | (FT ³ /MISSION |
| MODULE (SKYLAB, | | | | | | | | | |
| | | | | | | | | | • |

WATTS/CYCLE (BTU/HR/CYCLE) (.03) KG/M15510N (LR/M15510N)

MYMISSION (FTYMISSION)

WATTS/CYCLE (BTU/HR/CYCLE)

D2-118561-4

| | FIXED | MEIGHD | | Q <u>U.1 R F M F</u> | | |
|---------------------------------------|--------------------------|-------------------------------|-------------------------------------|----------------------|--------------------------------------|------------------------|
| APONENT | (REF) | 1 | WEIGHT (LBS) | | | VOLUME (FT3) |
| ILE /HOOD | (236) | ′ <u> </u> | 1.8 | | | <u> </u> |
| | | | | | | |
| | | _ | | | | |
| | | | | | | |
| | | | | | • | |
| | | | | | | |
| | TOTAL | | .816 (| (1.8) | .00 | 017 6.00 |
| | | | KG (LBS) | | , M | 3 (FT ³) . |
| | SOLID EX | <u> ENDABL</u> | | REQUIRE | MENIS | • |
| | • | Ø) WT/UNIT (PKC.WT/UNI | REF) WT/CY | CLE VOL | (4) /UNIT (REF) VOL/UNIT)(REF) (FT3) | AOT \C.ACTE |
| TYPE | UNITS/CYCLE(REF) | (PRI , WI / URI | 1)(REF) ①X((LB |) (PRG. | (FT3) | (FT3) |
| | | | | | | |
| | | | | | | |
| · | | | | | | |
| | | | | | | |
| · · · · · · · · · · · · · · · · · · · | | | Σ3 TOTAL WY | 7cycle | Σ③. | TOTAL VOLVEYCE |
| AL WT. | | | (LB | , | | (FT ¹) |
| CYCI | LES/DAY DA | WS/MISSION T | TOT.WI. YOU (Lb. | a | L | G (LB) |
| AL VOL * | ¥ | | Y (CD) | • | | |
| CYCI | LES/DAY DA | NS/MISSION | 101, VOL /CY((FT ³) | cī E | M: | (ربار) |
| | | | | • | | • |
| | <u>6 A S/L 1 Q U 1 D</u> | EXPE | | REQUIREM | | _ |
| | | ACIE(BEE) | • RECOVERY | AMT . RECOVE | D CD/CYCLE | AMT LOST/CYCLE |
| | 700325/0 | YCLE (REF) .B) | FACTOR | O x (L) | Ŋ | (LB) |
| TYPE N/A | • " | | | | | |
| N/A | | | | | | |
| N/A | | | | | | **** |
| TYPE N/A | | | | | | |

(LB)

TDAYS/MISSION 1 NOTAL TOSY/CYCLE 2

D2-118561-4

| HABITABILITY SUBSYSTEM | 2.0 | Personal Hygiene | |
|---------------------------|-------|-------------------|---|
| HABITABILITY FUNCTION | 2.3 | Personal Grooming | |
| APPLIANCE FUNCTION 2 | .3.4 | Teethbrushing | |
| NUMBER OF CONCEPTS CONSID | ered_ | 3 | • |

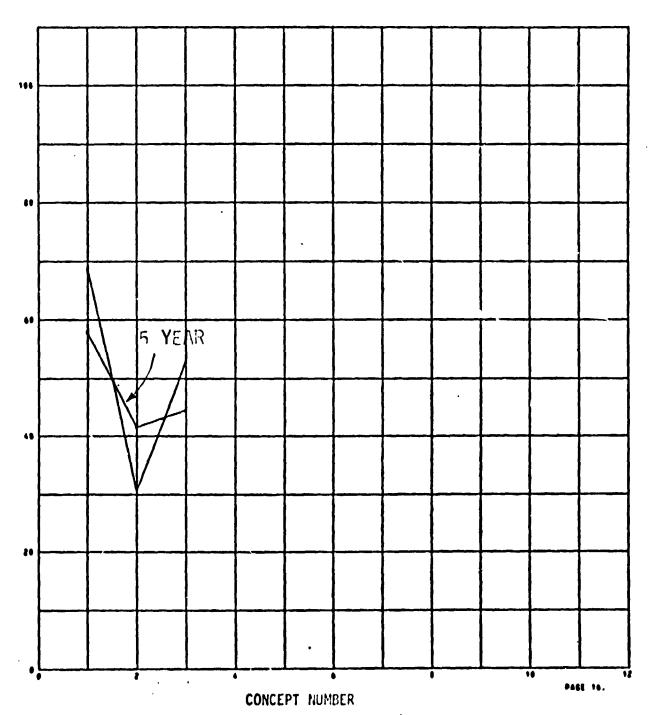
ASSUMPTIONS

- (1) The dental concepts are manual and electric. Manual brushing and water flushing are the concepts considered by the study.
- (2) The study assumed four brushings per day per man.
- (3) Teethbrushing is assumed to take 5 minutes per brushing.
- (4) Dental floss is provided for each concept for cleaning the crevices of the teeth. Each crewman is supplied a number of 50-foot rolls of dental floss as determined by mission length. The usage is based on approximately one foet per day per crewman.

| COMSUMABLES AND FLOW REQUIREM | ATHORN TAXOUT | | | |
|---|---|---|--|------------------|
| | norphy detroit | EC PER REGITS PT | AVOL REGNTS DEVELOPMENT | A Teens le |
| USES/DAY TYPE USED FLOW PRESS TEM MRS/USE (0) -KG/USE 0 OMH46 -DEG (LR/USE) (0) (9) (9516) (DEG | C C C C C C C C C C C C C C C C C C C | | 16HT VOLUME BVBIL 1WDER KG | 2 |
| | | 0 | .5 6 6 | 75.3 |
| .330 | - | • | 100.0 | 166.0 |
| 6.000 5 .0567 .68 1551.4 Z | 70.01. (0.1. 1. 27.1 | 24.0 24.0 1 | 3.51 (07) | ? ? · |
| • 139 | 0.0 1 7.1 | st 0.4 0. | | |
| ORIGINO PRODUCTION OF POOL | (*) 1 - CABIN AIR 2 - CABIN AIR 3 - COYGEN 4 - COLING WATER 5 - NATER 6 - NITROSEN 7 - NITROSEN 8 - FRECH 9 - KATER | (CIRCULATED), LITERS/SEC (LOST) , KG/HR (LOST) , KG/HR (CIRCULATED) , KG/HR (LOST) , KG/HR (LOST) , KG/HR (USED) , KG/HR (USED) , KG/HR (PROCESSED) , KG/HR | (18/43) (18/43) (18/43) (18/43) (18/43) (18/43) (18/43) (18/43) | |
| AU PAGE IN | (**) <u>AVAILABLE</u> (1) AVAILABLE (2) STATE OF THE ART (3) SONE DEVELOPMENT REQUIRED | | (***)COST INDICATOR 0-25% 25-50% 50-75% | |

APPLIANCE
CONCEPT
NO. CONCEPT HAME-

2 - WATER PIX 3 - FLECTRIC TOOTHRHUSH



Dental (Space Station) Concept Trade

| POSES PERSONAL SERVICES | , | | | | | | | | | |
|-------------------------|---|------------------|-----------|----------------------------------|-------------|------------------------|---|--|-----------|---|
| 3128 | SELECTION MATRIX | •! | 101/30/75 | • | TEE TH . 04 | NONING | BRUSHING (SPACE STATION) | | | |
| FACTOR VAL | MIN | MAR | 819 | _ | ~ | 0 | ONCEPT | | | |
| DE164T 3.5210 | ı | 173.00 | ٠, | • | | 8 5 | | | | |
| FORER | ē | 0.0000 | 2 5 2 v | 15.00 15.00 15.00 15.00 | 5-56 | 11.25 5.35 11.25 | | | | |
| 1 | | 1.0000 20.000 | i | 1 ! | 000 | 7.50 | | | | |
| RATING .000 | 00000 | 100.00 | 100 | 68.75 | 30.75 | 52.87 | | | 52-1 | |
| | | | | | | | | | 18561 | |
| | | | | | | | | | 4 | |
| | | | | | | | | | | |
| * | Marie de la companie | | | | | | *************************************** | | | • |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| 79118 | 8 | SEPSITIVITY AMALYSIS |
|----------------------------------|------------------|--|
| | SINGLE SELECTION | DE EACH CONCEPT AFTER INCREASING DA PARAMETER BEIGHTING FACTOR BY SO S TO ON 100 B MAX POINTS) |
| | | CONCEPT |
| | ~ ∶ | |
| MGRMAL - 68.75 | \$ 30.75 | 52.67 |
| BE1647 62.86 | • | 40.67 |
| ٠. | | |
| İ | 20.62 | 50.00 50.00 |
| OCV COST 71.43 | . j | 52.62 |
| | \$ | SEUSITIVITY ANALYSIS |
| 219x15 | RATING FOR | DR EACH CONCEPT AFTER INCREASING DN PARAMETER BEIGHTING FACTOR BY -50 8 CO ON 100 B MAX POINTS! |
| | , ~ | CONCEPT |
| • | 39.75 | 52.47 |
| 10.24 75.00 | | 57.74 |
| ì | 2 25.20 | \$2.03 \$0.50 |
| MA:NTENC 47.74 DEV COST 65.52 | 1 1 | \$2.70 \$3.17 |
| | | |

290733

|--|--|

| D5-11(8-2-4) SINGLE SELECTION PARAMETER RELIGIESSING (BASED ON 100 S HAX POINTS) LITTLE SENT STATES AND SENT STATES AND SENT STATES AND SENT SENT STATES AND SENT STATES AND SENT STATES AND SENT STATES AND SENT SENT STATES AND SENT STATES AND SENT SENT SENT SENT SENT SENT SENT SENT | | | | SENSITIVITY ANALYSIS | | |
|---|----------|----------|------------------|--|------------|----------|
| 55.00 41:43 44:50 55.00 41:43 44:50 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:53 55.00 41:45 41:45 55.00 41:45 4 | | STNGLE | SELECT SELECT | EACH CONCEPT AFTER INCREASING PARAMETER WEIGHTING FACTOR BY ON 100 B MAX POINTS! | | |
| \$5.00 11.43 41.50 \$5.00 11.43 | | | - | 3 U N U | | |
| \$51.65 \$5.75 \$11.53 \$41.50 \$5.70 \$11.53 \$41.50 \$5.70 \$11.53 \$41.50 \$5.70 \$11.53 \$41.55 \$41.55 | | | | | | |
| \$5.00 41.55 41.55 55.00 41.55 | | _ | 1.63 | | | |
| SENSITIVITY ANALYSIS SENSITIVITY ANALYSIS SENSITIVITY ANALYSIS SINGLE SELECTION PARAMITER REGAING SINGLE SELECTION PARAMITER REGAING SAND 41.63 1 2 3 C O N C E P T SAND 41.63 55.00 5 | ETGHT | 53.66 | 45.75 | 1 | | |
| \$8.77 4055 45.17 \$8.77 4055 45.17 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 41.25 \$5.040 45.87 45.20 \$5.040 45.87 45.20 \$5.040 45.87 45.20 \$5.040 45.87 45.80 \$5.040 45.87 45.80 \$5.040 45.81 45.80 \$5.040 45. | VOLUME | 55.00 | | , | | |
| \$50.77 44.65 \$50.70 30.59 44.05 \$50.70 30.59 44.05 \$50.70 30.59 44.05 \$50.70 30.59 44.05 \$50.70 5 47.00 \$50.70 44.05 \$50.70 41.00 \$50.70 44.05 | FL148-Y | į | 95.07 | • | | |
| \$31.00 19:58 41:90 \$21.00 19:58 41:90 \$21.00 19:58 41:90 \$21.00 10 10 10 10 10 10 10 10 10 10 10 10 1 | AINTENC_ | ĺ | -40.56. | - } | | |
| SENSITIVITY ANALYSIS RATING FOR EACH CONCEPT AFTER INCREASING RATING FOR EACH CONCEPT AFTER INCREASING (BASED ON 100 & MAX POINTS) (BASED ON 100 & MAX POINTS) 2 3 C O N C E P 7 SY-89 91-63 41-63 54.29 45.20 62.06 40.31 62.06 40.31 | EC COST | | ⊕ ₹2 ₹2 | , | | - |
| SENSITIVITY ANALYSIS SINGLE SCLECTION PARAMETER HIGHERSING SINGLE SCLECTION PARAMETER HIGHERSING SINGLE SCLECTION PARAMETER HIGHERSING (BASED ON 100 8 HAX POINTS) C O N C E P T S7.89 91.63 94.50 S6.28 55.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 45.20 91.89 56.28 91.80 56.28 91.8 | , , | | | | 00 | i i |
| SINGLE SELECTION PARAMETER INCREASING SINGLE SELECTION PARAMETER REIGHTING FACTOR BY ~50 S (BASED ON 100 S MAX POINTS) C O M C E P T C O M C E P T STAR WILLS 44-50 62.06 36-70 41-89 64.27 45-20 41-89 64.27 42-75 44-13 54.29 45-20 44-03 62.06 30-06 48-31 | | | | AHALYSIS | RIG F P | D2 |
| SINGLE SELECTION PARAMETER WINGRESING SINGLE SELECTION PARAMETER WINGRESING (BASED ON 100 & HAX POINTS) C O N C E P T S7.89 41.63 44.50 62.86 36.90 47.98 54.27 45.20 41.89 54.27 42.75 44.13 54.29 45.20 44.03 54.29 45.20 44.03 54.29 45.20 44.03 | | | | | [NA | -113 |
| 62.86 36.80 u7.98 62.86 36.80 u7.98 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 61.11 36.44 44.00 | | A LOW LA | ATING F | R INCREASING | II. | 85 |
| 57.89 41.63 44.50 62.86 36.80 47.98 54.29 45.20 41.89 54.27 45.20 41.89 56.76 42.75 43.85 56.76 42.75 44.13 54.29 45.20 44.03 54.29 45.20 44.03 | | | (84 | 151 | PAX | 61 - |
| 57.89 41.63 44.50 62.86 36.80 47.98 54.29 45.20 41.89 61.11 36.44 44.00 54.29 45.20 41.89 56.76 42.75 43.85 56.76 42.75 44.13 54.29 45.20 44.03 54.29 45.20 44.03 | | 1 | | CONCEPT | | 4 |
| 54.29 45.20 61.61 36.44 54.29 45.20 56.76 45.20 56.76 42.75 56.76 42.75 54.29 45.20 | NORMAL | 57.89 | *1.63 | 44.50 | | |
| 54.29 45.20 56.76 42.75 56.76 42.75 54.29 45.20 62.29 42.75 | E 1644 | 1 | 1 | | | |
| 54.29 45.20 56.76 42.75 56.76 42.75 54.29 45.20 62.86 36.66 | | , | | | | |
| 56.76 42.75 54.29 45.20 62.86 36.66 | HERMAL | 54.29 | | | | |
| 54.29 45.20 | AINTENC | 56.76 | | | | |
| COST 62:8636.6646:3 | EV COST | 54.29 | | | | |
| | | 2 . 8 | 36.66 | 46.3 | | |

APPLIANCE CONCEPT COMPONENT SUMMARY MATRIX

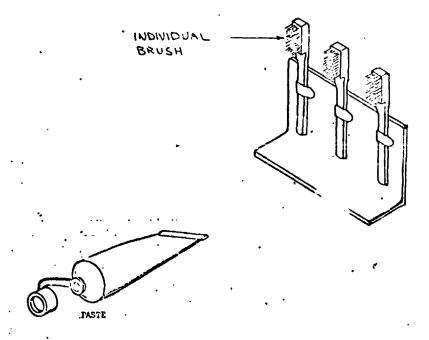
APPLIANCE FUNCTION: 2.3.4-TEETH BRUSHING

OF SAFETY CRITICAL NUMBER ITEMS z z 0 ۵. Σ 0 ပ L 0 œ ш ∞ ∑ СОИТВОГ**ГЕЯ** НІСН ЕВЕ**ОПЕИСУ** > ELECTROACOUSTIC TRANSMISSION CONTROLLER **4**WNd **ZOTOM** COMPONENT TYPE ULTRASONIC CLEANING DEVICE TOOTHBRUSH WITH DENTIFICE ELECTRIC TOOTHBRUSH WITH DENTIFICE APPLIANCE TYPE WATER PIX

| SPACECRAFT Space Station | |
|--|------|
| HABITABILITY SUBSYSTEM Personal Hygiene HABITABILITY FUNCTION Personal Groom | ming |
| APPLIANCE FUNCTION Teeth Brushing | |
| APPLIANCE CONCEPT NO./TITLE 1/Toothbrush with Dentifrice | |
| INDEX NO. 2.3.4.1 REF. NO. 236 | |

DESCRIPTION

The toothbrush with dentifrice concept consists of a terrestrial type toothbrush with dentifrice. The dentifrice is digestible to be nonhazardous if accidentally swallowed and is dispensed by a roll-up tube. Mouthwash is also provided in a soft plastic "squeeze bottle." One squeeze bottle per each crewman is provided for hygiene reasons. The mouthwash is used to mix with the dentifrice and is expectorated into a sink or fecal collector. This concept has flown on Apollo.



D2-118561-4

concept 1/ Tooth brush with dentrifice

INDEX NUMBER 2.3.4.1

| | | Λ (| POWE | R | D C | POWER ' |
|---|---------------------------|--------------------|-------------------------------|---------------------------------------|--------------------|---|
| COMPONENT (REF) | USE TIME CYCLE (HR) | (WATTS) | ③ AVERAGE (WATTS) | (4) DEMAND (WATT-HR/ CYCLE) (1) X (3) | (5) PEAK | (A) (B) DEMAN AVERAGE (1:ATT-H CYCLE) (WATTS) (WATTS) |
| | | | | | | |
| - 10 - 17 - 10 - 10 - 10 - 10 - 10 - 10 | | | | | | |
| , | | MUMIXAM | | TOTAL | MUMIXAM | TOTAL |
| SOURCE | | LATENT (BTU/HR) | SEN: | R E M E N T S SIBLE J/HR) | HEAT LEAK (RTU/HR) | TO COOLANT (BTU/HR) |
| • | TOTAL | WATT (BTU/HR) | WATT (| BTU/HR) | WATT (BTU/HR) | WATT (BTU/HR) |
| SOURCE N/A | | THERMAL TO ME (BTU | ALPE COOLANT /HR/CYCLE) | NALTIES ELECTRICAL (PK WATTS/CY | WEIGHT | VOLUME (FT³/MISSION) |

C2-343

(FB/HI2210N)

(NOTSSIM/^FM)

MAITS/CYCLE WATTS/CYCLE)
(BTU/HR/CYCLE)

TOTAL

כלכ

APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS (CONCLUDED)

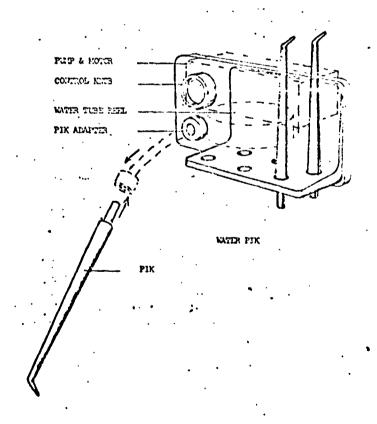
CONCEPT 1/1001H BRUSH WITH DENTIFICE INDEX INDEX NUMBER 2.3.4.1

| | EIXED ! | Y E I G H I/V O | LUME RE | <u>QUIREME</u> N | Ţ <u>S</u> | |
|-------------------------|--------------------------|--|-------------------------|--------------------|--|---|
| COMPONENT TOOTHBRUSH | ·(REF) (236) | | weight (lbs) 7,74 | | . (| VOLUME (FT3) 522 |
| DENTILKICL/N | 10VIHARA (236) | | 165.6 | | | .42 |
| | | | | | | |
| | | | | | • | |
| | TOTAL | . ` | 78.6 (/ | 73. 3) | .27 | (9.64) |
| туре | ① UNITS/CYCLE(REF) | ENDABLE WT/UNIT (REF) (PKG.WT/UNIT)(R | (LB) (X (∑ |) (PKG.VC | 4 E N I S (4) UNIT (REF) DL/UNIT)(REF) (FT3) | \$\\ \(\begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ |
| DENTI ERICE! | | | | 5 (23%) | | .001 (23 |
| | | Σ | 3 | cyair | Σ ⑤ | TOTAL VOL/CYCLE |
| TOTAL MT. MISSION CYCL | Z4 X X DAY | /84 SMISSION X | | | 75.6 | Z (165.6) |
| TOTAL VOL Z | ES/DAY DAY | 184 S/MISSION X | 10T.VOL/CYC | LE | /25 M3 | (4.42) |
| | <u>6 A S/L 1 Q U 1 D</u> | <u> </u> | LABLES R | EQUIREME | | |
| - N/A - | AMT.USED/CY (LE | CLE (REF) | RECOVERY FACTOR | AMT.RECOVERS (LB) | D/CYCLE | AMT LOST/CYCLE () - (3) (LR) |
| | | | | | | |
| t oral by | Σ ① | , | | | Σ : | |
| MISSION CYCLE/ | DAY DAYSTRICS | TATOL X NOTAL | DST/CYCLE • | (LB) (LB) | * | KG (Lti) |

| SPACECRAFT Spa | nce Station | | | | |
|---|-------------------------|------------------|---------------|------------------------|------|
| HABITABILITY S | UBSYSTEM <u>Persona</u> | <u>l Hygiene</u> | _HABITABILITY | FUNCTION Personal Groo | ming |
| APPLIANCE FUNC | TION <u>Teeth Br</u> | ushing | | | |
| APPLIANCE CONC | EPT NO./TITLE | 2/Water | Pix | | |
| INDEX NO | 2.3.4.2 | | REF. NO | 236,207 | |
| S50.00.00000000000000000000000000000000 | | | • | • | |

DESCRIPTION

The water pix concept is the same as the terrestrial type. One unit is provided with individual tips for each crewman. The unit is plumbed with water and wired electrically for power. The water pix creates a high velocity spray which is directed at the tooth crevices to loosen debris. The water is collected in the mouth and expectorated into a sink or fecal collector. The water is assumed to be recoverable by the study with the exception of the water loss due to suspended solids.



D2-118501-4 APPLIANCE CONCEPT REQUIREMENTS AND PENALTIES CALCULATIONS CONCLPT 2 /WATCK PIK INDEX NUMBER 2.3.4.Z ELECTRICAL POWEP REQUIREMENTS POWER POWER (7) DE::AND DEMAND 0 3 (3) **6** (WATT-HR/ CYCLI) (DX() (WATT-HR/ CYCLE PEAK AVERAGE PEAK AVERAGE CYCLE) COMPONENT (REF) (HR) (WATTS) (WATTS) (WATTS) (WATTS) 24 WATER PUMP (24) .083 24 2.0 2.0 MAXINUM TOTAL MUMIXAM TOTAL THERMAL REQUIREMENTS LATENT SENSIBLE HEAT LEAK TO COOLANT SOURCE (BTU/HR) (BTU/HR) (BTU/HR) (BTU/HR) TOTAL WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR) WATT (BTU/HR)

5/12

OPERATIONAL PENALTIES

| , | •• | THE | | ELECTRICAL | WEIGHT | VOLUME |
|------------|----------------------------|-------------------------------|-------------------------------|------------------|----------------------------|--|
| <i>'</i> . | SOURCE | HEAT LEAK (BTU/HR/CYCLL) | TO COOLANT (BTU/HR/CYCLE) | (PK WATTS/CYCLE) | (LB/MISSION) | (FT ³ /MISSION) |
| | N/A | | ٠. | | • | n di Mala di Miliangano ka ajampilan d |
| | | | | | | |
| | | | | - | | |
| } | بشده بهروسومشوم وريعسه وسط | | | | | • |
| | | | | **** | | |
| • | TOTAL | | | | | |
| | | WATTS/CYCLE (BTU/HR/CYCLE) | WATTS/CYCLE (BTU/HR/CYCLE) | | KG/MISSICN (LB/MISSION) | M*/HISSICY (FT*/MISSION) |

D2-1185C1-4

APPLIANCE CONCEPT REQUIFEMENTS AND FENALTIES CALCULATIONS (CONCLUDED)

CONCEPT 2/WATCH PIX

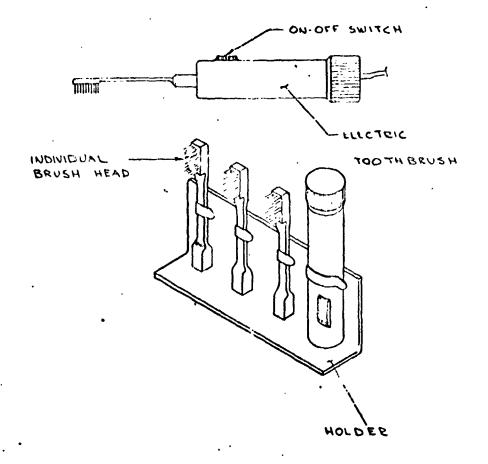
INDEX NUMBER 2.3.4.2

| | <u>F 1 X</u> | ED F | <u>EIGHT</u> | Norn | ME RFS | SATE | MENIS | |
|----------------------------|--------------------------------|-----------------|--|------------------------------|-----------------------------------|----------|--|---|
| COMPONENT | ASSY. | (REF) (236) | ' <u>-</u> | | WEIGHT (LES) 2.88 | | | VOLUME (FT ³) -09 4 |
| | | | | | | | | |
| | | | | | | | | |
| | | TOTAL | . " | 1 | 3/ (Z-8 KG (LBS) | 98)] | | 0027 (094) N ³ (FT ³) |
| TYPE -N/A - | \$ 0 L 1 D UNITS/CYCL | | ENDAB (? WT/UNII (PKG. WT/UN (LB |) (REF) (IT)(REF) | (r3) ①x⊙ M.\can 1.\v ō r | E | I REMENTS VOL/UNIT (RCF (PKG. VOL/UNIT)((FI3) | S) VOL/CYCLE |
| | | | | Σ3 | TOTAL WI/C | YCLE | · Σ | TOTAL VOLVEYCLE |
| | ES/DAY | DAY | S/MISSION | x | 101.k1/CYCLE (LB) | | | KG (LB) |
| IOTAL VOL MISSION CYCLI | ES/DAY | MDAY | S/MISSION | x | 707.VOL7CYCL (FT³) | <u>.</u> | · | N ³ (F1 ³) |
| TYPE WATER, _ | <u>6 A S/L 1</u> | T.USED/CYI |) CLE(REF) | | LES RECOVERY FACTOR | | REMENIS CONVERTO/CYCLE (18) (2489 | AMT LOST/CYCLE () - (3) (1.8) |
| · i | ΣΦ | ./2 | 5 | | | | Σ@ | .0001125 |
| TOTAL WT | <u>r</u> _{UAY} x — | 184 Mis/Miss | เอร ^{าร X} 1ชี | 0001) TAL 1051/ 12 (4) | 25 • <u>4</u> | 27_ · | 125 6 0 | . Z82 (.622) |

| SPACECRAFT Space Station | |
|------------------------------------|--|
| HABITABILITY SUBSYSTEM Personal Hy | giene HABITABILITY FUNCTION Personal Groomin |
| APPLIANCE FUNCTION Teeth Brush | ing [.] |
| APPLIANCE CONCEPT NO./TITLE 3/E1 | ectric Toothbrush with Dentifrice |
| INDEX NO. 2.3.4.3 | REF. NO236,207 |
| | |

DESCRIPTION

The electric toothbrush with dentifrice concept consists of a motor-driven toothbrush with individual brushes for each crewman. The same dentifrice and mouthwash used for Concept 1 are utilized for this concept. The vibratory action of the toothbrush has the advantage of massaging the gums as well as cleaning the tooth. The unit is wired electrically to provide power to the unit.



D2-118561-4

APPLIANCE CONCEPT PEQUIPMENTS AND PENALTIES CALCULATIONS CONCEPT 3/ELECTRIC TOUTHBRUSH WITH DENTIFICE

.45

INDEX RUMPER 2.3.4.3

MyM188164 (F1 'M188164)

KG/MISSION (LB/MISSION)

| | | IRICAL P | OWER POWE | | D | C POWI | R |
|-----------------|---------------------|--|----------------------|-----------------------------------|----------------------------|-----------------|------------------------------------|
| OVPOVIENT (REF) | USE TIME CYCLE (HR) | PEAK (WATTS) 6.0 | O AVERAGE (WATTS) | DEMAND (WATT-HR/ CYCLE) (D) 7 (3) | (WATTS) | AVERAGE (WATTS) | DEMA (MATT- CYCLE (I) X (|
| | | 6.0. | | .5 | | | |
| ٠. | | MAX I MUM | | TOTAL | MAXIMUM | | . TOTAL |
| | | THERMAL. | REQUI | <u>R F M E N T S</u> | | | |
| SOURCE | | LATENT (BTU/HR) | | SIBLE U/HR) | HLAT LEAK (BTU/HR) | | COOLANT BTU/HR) |
| MOTOR | | | _6 | .75 | 6.75 | | |
| | | | | | | | |
| | TOTAL | WATT (BTU/HR) | | (6.75) (BTU/HR) | 198 (6.7) WATT (BTU/HR) | | T (BTU/HF |
| | , | | | | | | • |
| | | <u>O P E R A I I O N</u> | <u>A</u> I. P E | NALIIE: | <u>s</u> | | , |
| SOURCE | | THERMAL T LEAK TO L/CYCLE) (BTU/ | COOLANT HR/CYCLE) | ELECTRICA (PK WATTS/C | | | VOLUME 3/MISSICR |
| | | | ٠. | | • | | |
| - N/A - | | | | | | | |

WATTS/CYCLE (BTU/HR/LYCLE)

TOTAL

WATTS/CYCLE (BTU/HR/CYCLE)

| | | GHI/YOLUME R. | EQUIPEMENTS | VOLUMĒ |
|--|--------------------------------------|--|-----------------------------------|--|
| COMPONENT <u>ELLOWIC TLAINBRUS</u> DENTLEGIGE INCLIN | ·(REF) [[ASS (256) UNIVA (236) | (LBS) | | (ii) _c125 _4.12 |
| | | | | |
| | | | | |
| | TOTAL | 75.4 (10 KG (LLS) | (6.3) | .126 (4.46) M ³ (FT ³) |
| | O (PKG | (/UNIT (REF) WT/C (LWT/UNIT)(REF) (1)X (LB). (LI | YCLE VOL/UNIT (P | EE) VOLACYCLE |
| | | Σ① .03 | 75 | Σ () .001 |
| OTAL NT. 24 MISSION CYCLES/DAY | x189 | 701/AL K (L) 7 SSICA X 03** | | 26 10/10 100 / (FT) 75.12 (165.6) |
| MESSION 24 CYCLES/DAY | x 184 DAIS/III | (LB) x | • [| .125 (4.42) |
| . <u>6 A</u> S/ | Q | EXPENDABLES ② | REQUIREMENTS ANT. PECOLETED/CYCL | |
| TYPE N/A | AMT.USED/CYCLE(| REF) RECOVERY FACTOR | ΔΝΤ, ΡΕ (*) (LB) (LB) | (18) |
| | | | | |
| Σ ① | | | Σ | • |
| MISSION CYCLE/DAY | MANSYMISSION | 1017ET OSTICACIT | (LB) (z (1) | Ku (Lb) |